CONCRETE

CONSTRUCTIONAL ENGINEERING

INCLUDING PRESTRESSED CONCRETE

MARCH 1961



VOL. LVI. NO. 3

PRICE 2s.

LEADING CONTENTS

Statically-indeterminate Structures					93
A General Equation for Frame Anal By Prof. A. L. L. Baker, D.Sc.(Eng.), N		M.I.St	ruct.E.		97
The Substructure of the Forth Road	Bridg	• .			105
The Design of Eccentrically-loaded (Circula	r Colu	imns	by	
By J. D. Bennett, B.Eng					111
Book Reviews					118
Lift-slab Method of Construction					120
Concrete Piers for the Tamar Road	Bridge				130

ISSUED MONTHLY

BOOKS ON CONCRETE For Catalogue of "Concrete Series Books on concrete and allied subjects, send a postcard to: For Catalogue of "Concrete Series" books on

CONCRETE PUBLICATIONS LTD., 14 DARTMOUTH ST., LONDON, S.W.I.

INDEX OF ADVERTISERS

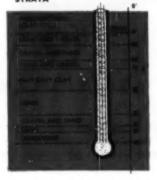
	Page :		Page
A.B. Moule & Constauction Co. Ltd	ERRIE	LAND & SON (STAINES) LTD. LECA (GREAT BRITAIN) LTD. LEEDS ON & GREAGE CO. LTD.	Service of
AC.E. MACHINERY LTD. ALLAM, B. P., & Co. LTD. ATLAS STORE CO. LTD.	. 16	Luca (Garar Buttatu) Luca	
ALLAM, B. P., & Co. LTD.	laxin	LEEDS On & Gonzan Co. Len	- miles
ATLAS STOWE CO. LTD.	. xii	LENGUARE LTD.	. zivi
		LILLINGSON CRONDE & Co. Lee	. zivi
		Lum Bran A Co Lon	. RRIG
BERRY'S ENGINEERING CO. BOULDER EQUIPMENT LYD. BOVER, WW., & SOME LTD BRAITSWATTE & CO., EMOSPHERS LTD BREY, ROSERY, & SOMS LTD. BREY, ROSERY, & SOMS LTD. BRITISH OXYGEN CO. LYD. BYEND, A. A., & CO. LYD. BYEND, A. A., & CO. LYD.	lws	LEMERTE LTD. LILLINGTON, GEORGE, & CO. LTD. LIND, PETER, & Co. LTD. LONGOEN, GEORGE, & SON LTD.	- 99
BOULDER EQUIPMENT I'm		Democrat, Carocar, & Son Little	4 ~
Boyen Wu & Sour Len	Bennatti		
Bearmann & Co. Vacconnes Los	· HAVER		
BRC Francisco Co., EDGISERED LTD.	1	McCala & Co. (Surprinto) Ltd	. zviii
D.R.C. ENGINEERING CO. LTD	- SCH	McCalle Macallov LTD. McKinsky Foundations LTD.	EXM
DREIT, ROBERT, & SONS LTD.	100 Sec. 75.50	McKinggy Foundations Len	axviii ix
DRITION UNYORN CO. LTD	Luxin		
BRITISH STREEL PILING CO. LTD	BERYR	MASONITE LTD. MAY & BUTCHER LTD. MILLARS' MACHINERY CO. LTD. MILLARS' SCAPPOLD CO. LTD.	
Byrs, A. A., & Co. Lyp.	lasv	May & Bonesses Lan	-
		Marriage Process Line	NINE
		Married Married Co.	- Lucy
CAMER COVERS LVD	MIS	MILLARS MACHINERY CO. LTD.	10 0
CAPLIN RUGINIERIUS CO Los		MILLO SCAFFOLD CO. LTD. MODULAR CONCRETE CO. LTD. MONES, A., & CO. LTD.	
CARRENTE SAND & COLUMN CO LOS	Inte	MODULAR CONCRETE Co. LTD.	. lanvi
Comments dans a Charle Co. Lip.	- ARIX	MORE, A., & Co. LTD.	- wwi
COMBRET MARKETING CO. LTD.	2 A AME	MULCASTER, WH., & CO. (CONTRACTORS) LTD.	. 1
CEMENT & STREET LTD.	THE WAR		
CAMER COVERS LTD. CAPTAINE EMGRIEBERSO CO. LTD. CAPTAINE SAITO & GRAVEL CO. LTD. CEMERT MARKETING CO. LTD. CEMERT MARKETING CO. LTD. CHERTHAM, ALEX. J., LTD. CHERTHAM, ALEX. J., LTD. CHERTHAM, ALEX. J., LTD. COMERTA & NILLERS LTD. COMERTS AN INLESS LTD. COMERTS PROGRESO LTD. COMCRETE PLOGGES C.	IVER .		
CHEMICAL BUILDING PRODUCTS LTD	lavii	Overta Concessionera Lan	
CHRISTIANI & NIKLSEN LTD.	Initi.	OMBLA CONSTRUCTIONS LTD.	9 7000
COMEN, GRONGE, SONS & Co. LTD.	Inxxu		
COLCRETE LTD.	. Drai		
CONCRETE PILING Len.		P.S.C. EQUIPMENT LTD.	lviti, lin
CONCRETE PRODUCE CO Les	- www.in	PARKEY & TRICKETT LTD.	N.S.
Concern Proper Co. Lan.	MARIN.	PARMLEY & TRICKETT LTD	inniv
Communication & Co. Lett.	AAU	POWELL DUPPRYN TIMBER INDUSTRIES LTD.	. 100.000
Communication of Co. Lib.	- IXVIII	PRESTREAMEN SALES LID.	-
COWLES, WM., & SON LID , , ,	4 44	Purpose W. A. Sone Line	NÍV, EV
		Brownson Harry Co. Lan.	. Xii
		PRIEST, B., & SOWS LYD. PUMPCREY HIRE CO. LYD.	. xlviii
D.A. MODELS LTD.	- HI		
DANDRIDGE, J. & A., LTD.	The same of		
DAVIDSONS PAPER SALES LTD.	3.10 W.	RANALAH STEEL MOULDS LTD	. liv
De long	TO STATE OF THE PARTY.	RAMAAH STEEL MOULDE LTD. ROVER CAR CO. LTD. ROSH & TOMPRINS LTD. RVIANDE BROTNERS LTD.	Invi
Dickers, Sevine B. Len	wwwiii	Ross & Tompsons Lun.	lunn
Donway Love & Co. Lon	- Annie	HYLANDS BROWNERS Len	NAME OF STREET
Drugger Bosses M. (Coursesson) Lee	will will	THE PARTY OF THE P	ANN
Denistration of the state of th	Silli, Milli		
D.A. MODELS LTD. DAMBRIDGE, J. & A., LTD. DAVIDGOUS PAPER SALES LTD. DE JOHG DECEMBE, STUART B., LTD. DORBAN LUNG & Co. LTD. DOUGLAR, ROBERT M. (CONTRACTORS) LTD. DUGGATUBE & WIRE LTD.	· KKY		
		SEALOCRETE PRODUCTS LED.	. lxv
		STABLER GONCRETE PILES LTD. STELMO LTD. STELMO LTD. STELMO LTD. STELMO LTD. STORE GOURT BALLAST CO. LTD. STORE GOURT BALLAST CO. LTD. STORES GOURT BALLAST CO. LTD. STORES MOR T., & CO. LTD. STEESBAND DEVELOPMENTS LTD.	. xlix
ENGINEERING DESIGN & CONSTRUCTION LTD.	. Inuit	STELMO LTD.	laxvii
Expanders Ltd	. Ivii	STERT PRECAST CONCRETE LYD.	, al
		STIC B PAINT SALES LTD.	THE
		STORE COURT BALLANT CO. LTD.	Wei
FARR, A. R., Lyn.	275 - 3	Strong Ww T. A Co. Len	white
PLEXIBLE DRIVE & Tons Co. Lyp.	www.in	STREAME DEVELOPMENTS Len	- Alley
Forn Moron Co. Lan	manufill .	STREETING DEVELOPMENTS LTD. STUART'S GRANOLITHIC CO. LTD.	
Engagement of the	AAAM	GIVARI & GRANGLITHIC CO. LTD	RVI
FARR, A. E., LTD. PLEXIBLE DRIVE & TOOL CO. LTD. FOOD MOTOR CO. LTD. FRANKIPILE LTD.	300.		
		TARMAC LYD.	
VA. B PALINFORCEMENTS LYD.	IRRRIV		-
THERESON, M. J. (CONTRACTORS) LTD.		IMAMES PLYWOOD MANUPACTURERS LTD.	. vi
COUNTR CONSTRUCTION CO. LTD.	. navi	T.P. POLYPLASTIC CONVERTERS LTD	. vi
G.K.N. RAIMPONCEMENTS LTD. GLESSON, M. J. (CONTRACTORS) LTD. GUNSTR CONSTRUCTION CO. LTD.		TRENT GRAVELS LTD.	. lzviši
		TRUCK-MIX (MIDLANDS) LTD.	-
HALL & Co. Led.	100000	TURWEL PORTLAND CEMENT CO. LED.	Inchill
HILTON GRAVES LID.	Twill		(KKKII)
Hall & Co. Led. Minton Gravel Led. Holef & Co. Les. Huwiley & Searns Led.	1000		
However & Seasons Lyn		Change Change of Comments of C	
Andrews or records from		Unistrut Division of Sankey-Shelbon Ltd.	lx.
Indea Commune (Dunman) Lon	- manuality		- F - F
IDEAL CASEMENTS (READING) LTD.	**************************************	VOLKHARH, O. A.	
IDEAL CASEMENTS (READING) LTD. IMPERIAL CHEMICAL INDUSTRIES LTD.	The second		
		Walker Wright & Co. Ltd	ERRY
JOHNSON, RICHARD, & NEPHEW LTD	. 3350	WHLBECK TRADING CO. LTD.	
JONES, T. C., & Co. Lin.		WELLERMAN BOOK LOD	
	THE PERSON NAMED IN	WELLERMAN BROS. LTD. WESTWOOD, JOSEPH, & Co. LTD. WHITEMEAD IRON & STEEL CO. LTD.	xxiii
		Warrange I have & Source Co. Lon.	
Kanyan-Gannyoon & Co. Lyn	944	WHEN DAY MODERS & CO. L. L. L.	. R, 2i
Kanea-Gazerwood & Co. Lyb	an mad	WHITLEY MORAY & CO. L.T.D.	. Xvi
And I say a con talk	KERVI	WINGST LIB.	- Mix
		WRITLEY MORAN & Co. Ltp. WINGET LTP. WOLF ELECTRIC TOOLS LTD.	TREVIS
Control Assessment Control Co.	12 4 11 4		
LAFANGE ALUMINOUS CEMENT CO. LTD. LAWLER, AYERS & Co. LTD.	· IXXXI		
LAWLER, AVERS & Co. LTD.	- Evil	VORKORIAR HERITERIQUE CONTRACTING CO. LTD.	
	THE RESERVE TO SHARE THE PARTY NAMED IN	and the same of th	-

facts

SALFORD MULTI-STOREY FLATS







PROBLEM

The Multi-Storey Blocks of Flats had to be sited on an old flood plain of the River Irwell, where a great variation in alluvial deposits occurred overlying sandstone bedrock.

The rock level varied from 11' to 43' below existing ground level and there was a high and variable water table.

SOLUTION

Franki 16/17' dia. driven in situ piles were selected for this work as providing a firm foundation by transference of load from the superstructures, through waterlogged material, to bedrock. This system proved eminently satisfactory in not only compacting the loose alluvial deposits, but also being able to contend with variations in pile length from 14' to 43' in the most economical manner.

Contract No: 3048 · Client: Salford City Council · Location: Salford · Architecta: Cruickshank & Seward City Engineer: G. A. McWilliam, B.Sc., A.M.I.C.E., A.R.I.C.S., M.I.MUN.E.

Contractors: Salford Direct Works Dept.

Truscos, Ltd., The Fram Reinforced Concrete Company Ltd., Matthews & Mumby Ltd.

Type of Structure: Multi-Storey Flats · Number and Type of Piles: 1801 Franki Driven

Working Load: 50 tons · Average Length: 21 feet

FRANKIPILE

Write for "The FRANKI systems of Piling"

FRANKIPILE LIMITED - 39 VICTORIA STREET - LONDON - S.W.1 - TEL: ABBEY 6006/9

INDEX OF ADVERTISERS

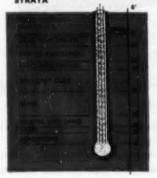
A.B. Mould & Compression Co. Ltd. A.C.E. Machibray Ltd. Allar, E. P., & Co. Ltd. Avlas Store Co. Ltd.	SHIP AND ASSESSED.		Page
A.B. MOULD & CONSTRUCTION Co. LTD.	XIANI	LAWS & SON (STAINES) LID.	SERVICE SERVIC
A.C.E. MACHINERY LTD.		LECA (GREAT BRITAIN) LTD.	
ALLAN, E. P., & Co. Lyp.	- in with		zivi
Arras Sooms Co. Len	-1	Lancarre Lyb. Lillandroon, Gamese, & Co. Lyb. Lillandroon, Gamese, & Co. Lyb. Loweshey, Gamese, & Seet Lyb.	· MAL
Allens Stone Co. Lin.	CONT. CO. CO. CO. CO. CO. CO. CO. CO. CO. CO	LEUSCHETE LTD	. sivi
		Lillington, Guonge, & Co. Lun.	. RRIG
		Leen, Perrya, & Co. Lyn.	. VIII
Benny's Bugingering Co	in in	Louisian Conner A Son Lan	
BRANN'S HISCHMERRING CO. BOULDER EQUIPMENT LTD. SONYAS, WH., & SONS LTD. BRANTEWATE & CO., EMBRISHMEN LTD. BRANT, ROMERT, & SONS LTD. BRANT, ROMERT, & SONS LTD. BRANT, ROMERT, & SONS LTD. BRANTS BRANCH CO. LTD. BRANTS BREET. PLING CO. LTD. BRANCH CO. LTD. BRANCH CO. LTD.	The same boy	Desirable Constitution of State Pills	4 7
BOOLSER EQUIPMENT LID.			
DOYER, WH., & SOME LTD	. laviii		
BRATTEWATTE & Co., Escrituses L.T.		McCall & Co. (Suppress) Lyp	200
B.R.C. Engrepoine Co. Len	. meši	MOCKEE & CO. (SMESPEED) LID	. EVIII
Brown Rosson & Com Law	All the same of the same	McKenney Foundations Lyp.	EXVI
DERTY, MUSICAL, & SURE LTD		MCKINNEY FOUNDATIONS LTD.	-
DELINE UXYORN CO. LTD.	. lanis		
Burrow Street, Pilling Co. Lyn.	REEVE	MAGORISE LTD. MAY & BUYCHER LTD. MAY & BUYCHER LTD. MILEANE FLOOR LTD. MILLARS MACHISHEY CO. LTD. MILLARS CAPPOLD CO. LTD.	. Ivi
Boxe, A. A., & Co. LTD.	IRRY	MARGINE LTD.	-
Decided for the St. Co. Line		MAY & BUTCHER LTD.	. zlvii
		MILEANE FLOORS LTD.	. Inier
		Mintane! Machinery Co. Lyn	
CABLE COVERS LTD. CAPLINE ENGINEERING CO. LTD. CASTLERILL SAPP & GRAVEL CO. LTD. CEMENT MARKETING CO. LTD. CEMENT & STREEL LTD.	A SHE	MILLS SCAPPOLD CO. LTD.	
Camer Burnersone Co Lee	BEAR WANT	MILLS SCAFFOLD CO. LYD.	-
CAPELIN BRUINEERING CO. LID.		MODULAR CONCRETE CO. LTD.	. lazvi
CASTLEMEL SAND & GRAVEL CO. LTD	. luiz	Mouk, A., & Co. Len.	. REI
CEMENT MARKETING CO. LTD.	146	MULCASTER, WH., & Co. (COUTRACTORS) LTD.	n al
CRMENT & STREE LTD.	Will will	MULLINESS, WELL & CO. (COUTEACHORS) LED.	100
Company of Acres & Low	CONTRACT CONTRACT		
CHERTHAN, ALEA, J., LID.	. zzvi		
CHEMICAL BUILDING PRODUCTS LTD	lxvii	Owner Character Van	
CHRISTIANI & NIBLARY LTD.	bill	OMBIA CONSTRUCTIONS LTD.	-
CRMENT & STREEL LTD. CREATMAN ALEX J., LTD. CREAMCAL BUILDING PRODUCTS LTD. CREAMCAL BUILDING PRODUCTS LTD. CREAMCAL BUILDING PRODUCTS LTD. COMMIN GROSOG, SOMS & CO. LTD. CONCERTE PLUID LTD. CONCERTE PRODUCTS CO. LTD. CONCERTE PRODUCTS CO. LTD. CONCERTE PUNC CO. LTD. COWLIN, WM. & SOM LTD.	burnis		
COMME, CHANGE, COURS & CO. LID.			
COLCRETE LYD.	. laxi	BOA BUILDING	
CONCRETE PILING LTD.	1	P.S.C. Equipment Ltd.	lvili, lix
Concaver Property Co. Les	SERE	PARKERY & TRICKETY LTD	. EX
Comments Provide Co. 1210.	DASTV.	Prevance Len	. IRRIV
CONCRETE PURP CO. LYB	XXX	Bourses December Towns Lawrence Co.	· PERIO
COMEYBEARE & CO. LTD.	. lavai	PONYASHLO LTD POWELL DUPRAYN TIMBER INDUSTRIES LTD.	-
COWLIN. WH. & Son Lyn.		PRESTRICTOR SALES LID.	KIV. EV
		PRIMAR, B., & Sous Lyp.	. zii
		PUMPCART HIME Co. LTD.	. sivin
		TOWNSHIEL STORE CO. LIES.	- ALTER
D.A. Models Lin.	O. M.		
DANDRIDGE, J. & A., LTD. DAVIDGE PAPER SALES LTD. DE JONE			
Davensone Pages Carne Lon		RABALAN STREE MOULDS LTD	0 0 mg
DAYIDSON'S PAPER SALES LID			
De Jone	The second second	ROYER CAR CO. LTD	. lavi
DICKENS, STUARY B. LTO.	- Exem	RUME & TUMERING LTD.	. IXXX
DORMAN LONG & Co. Lon	armin.	RUME & TOMPRINE LTO. BYLANDS BROWNERS LTO.	. REEV
CORMAN LONG OF CO. LEW,	VIEE .	SOURCE MANAGEMENT STATES .	· AREV
DECREUS, STUARY B., LTD. DORMAN LONG & CO. LED. DOUGLAS, ROBERT M. (CONTRACTORS) LTD. DURATURE & WIRE LTD.	100 x566		
DURATURE & WIRE LTD.	XXY		
		SEALOGRETE PRODUCTS LTD	. Inv
		SEMPLEA CONCRETE PILES LID.	. wife
EMMERSHAG DESIGN & CONSTRUCTION LCD.	. luxii	STELMO LTD	lxxvii
Explosing Lyb.	No.	STREET PRECEST CONCRETE LTD.	. 15
	al area la line	Sour B Party Salve Lon	FRE
		STORE COURT BALLARY CO. LTD. STORER, WM. T., & CO. LTD. STRESSING DEVELOPMENTS LYD.	· XXXX
		STORE COURS DALLAST CO. LID	. niiv ziv
FARE, A. E., LTD.		STORER, WM. T., & Co. LTD.	. she
PARE, A. B., LTO. PLEZIBLE DRIVE & Tool Co. LTO.	MARIY	STREETING DEVELOPMENT LYN	when
Power Morrow Co. Low	- axxiii	STUART'S GRAMOLITHIC CO. LTD.	-
PORCE MICHIGAN CAN LID.		STURE STRANGETIME CO. LID.	· MAS
FORD MOTOR Co. LTD.	iii		
DOWN SO BUILDINGS TO SEE	Towns or .	TARMAG LTD.	-
C. K.N. REINFORGEMENTS LTD	laxxiv	Tannon Bin Co. Ltd.	-
GLEESON, M. J. (CONTRACTORS) LTD.	A - 200	THAMES PLYWOOD MANUEACTURES LTD.	. vi
GUNITE CONSTRUCTION CO. LTD	xxvi		
The state of the s		T.P. POLYPLASTIC CONVERYERS LTD	ARIV
		TRENT GRAVELS LTD	. larvini
		TRUCK MER (MIDIANDS) LID.	Section 1
HALL & CO. LYD.	THE CAME OF THE	FURNEL PORSLAND CEMENT CO. LTD	incall.
MILTON GRAVEL LTD	lati	The state of the s	- BARRIE
Moreo & Co. Lon			
Hoter & Co. Lrs.	2	THE PARTY OF THE P	
HUNTLEY & SPARES LYD	-	UNIVERSET DEVISION OF SANKEY SHELDON LID.	. In
		The state of the s	
Sparry Companies (Walnut Co.)	manual Comment	THE RESERVE OF THE PARTY OF THE	1000
TOTAL CAMBERTS (READING) LTD.	EXEVE	VOLEMANN, O. A.	1
IDEAL CAMMENTS (READING) LTD			
The state of the s			
		Warran Warran & Co. Lon	The same
Committee Brancisco & Management &	The same of the sa	MALKER WRIGHT & CO. LTD	ESSA
JOHNSON, RICHARD, & Naphew Lep	HERE	WELDECK PRADING CO. LTD.	-
Jones, I. C., & Co. Ltp.	. ERE	WELLERMAN BROS. LTD.	72572
THE RESERVE OF THE PARTY OF THE		Western Louisia A Co. Louis	700
THE RESERVE OF THE PARTY OF THE		The state of the Lite.	· XXIII
	1000000	WHITEMEND TROS & STREET CO. LID	. 3, 31
RABBER GREENWOOD & Co. Lys.	. Ini	WHETERY MORAN & CO. LTD.	. Evi
Kisso, J. A., & Co. Lvo.	EXEV	WALKER WROST & CO. LTO. WELDEN FRACIPAC CO. LTO. WELDEN AND BOOK LTO. WESTWOOD, JOSEPH, & CO. LTO. WESTER MORAD & CO. LTO. WESTER LTO. WITTEN MORAD & CO. LTO. WITTEN MORAD & CO. LTO.	- XIX
I I A STATE OF THE OWNER WHEN THE PARTY OF T		Wole Ellernic Tools Lyp.	
		NAME OF PERSONS IN THE PERSON OF PERSONS IN THE PERSON OF PERSON OF PERSONS IN THE PERSON OF PER	IXXVIII
LAPARGE ALUMINOUS CEMENT CO. LTD.	. luxui		
LAWLER, AVERS & Co. LTD	XVII	YORKHURE HENNEMOUR CONTRACTING CO. LTD.	73.4

facts

ORD MULTI-STOREY FLATS







The Multi-Storey Blocks of Flats had to be sited on an old flood plain of the River Irwell, where a great variation in alluvial deposits occurred overlying sandstone bedrock.

The rock level varied from 11' to 43' below existing ground level and there was a high and variable water table.

SOLUTION

Franki 16/17" dia. driven in situ piles were selected for this work as providing a firm foundation by transference of load from the superstructures, through waterlogged material, to bedrock. This system proved eminently satisfactory in not only compacting the loose alluvial deposits, but also being able to contend with variations in pile length from 14' to 43' in the most economical manner.

Contract No: 3048 · Client: Salford City Council · Location: Salford · Architects: Cruickshank & Seward City Engineer: S. A. McWilliam, B.Sc., A.M.J.C.E., A.R.J.C.S., M.I.MUN.E.,
Contractors: Salford Direct Works Dept.
Truscon Ltd., The Fram Reinforced Concrete Company Ltd., Matthews & Mumby Ltd.

Type of Structure: Multi-Storey Flats · Number and Type of Pilos: 1801 Franki Driven Working Load: 50 tons · Average Length: 21 feet

FRANKIPILE Write for "The FRANKI systems of Piling"

FRANKIPILE LIMITED - 39 VICTORIA STREET - LONDON - S.W.I - TEL: ABBEY 6006/9



IN CONCRETE ROAD CONSTRUCTION

Recommended qualities for concrete work are seco No. 40 to ass 1521/1949 Class B and seco No. 60, the choice depending on the stresses involved. The former fully meets the specification at the lowest possible cost. As well as preventing seepage from the mix seco also checks the upward penetration of harmful acids and other chemicals frequently occurring in subsoils. It also has useful applications as a curing overlay. There is no free bitumen in seco to sweat out under exposure to bot sun. We will gladly send samples on requeet.

For the essential retention of water in a concrete mix to ensure sound setting and hardening, careful contractors are more and more depending on IBECO...

Like no other waterproof paper, IBECO is waterproof throughout its texture. The proofing bitumen is part of the paper itself. Folding, creasing, even heavy trampling will not impair IBECO's impermeability...

It's easy and quick to handle—speeds the work as well as lowering its cost and ensuring a better job.

Remember IEECO for contracts in hand and in prospect.

Davidsons Paper Sales Ltd. Head Office: Mugiemoss Mills, Bucksburn, Aberdeen.

LONDON: 82/84 St. John St. E.C.I. LIVERPOOL: 31 North John St. 2. LEEDS: 9 Albion St.

NEWCASTLE: 42 Corporation St. GLASGOW: Laird Place, Bridgeton, SE.

EDINBURGH: Boroughloch Square. ABERDEEN: 4 Trinity Quay. DUNDEE: 24 Lamb's Lane.

YORKSHIRE HENNEBIQUE

Contracting Co. Ltd.

ESTABLISHED 1904

CIVIL ENGINEERING CONTRACTORS

HEAD OFFICE:

HENNEBIQUE HOUSE
The Mount · York

Telephone: YORK 54656 (4 lines)

Branch Offices:

HULL: 30 WINCOLMLEE. Telephone: Hull 29501 LEEDS: ROYDS WORKS, LOWER WORTLEY, LEEDS 12. THAMES A smooth shuttering without



These 14 ft. columns for an office and warehouse block in City Road, London, were poured in one lift. Photo by courtesy of the contractors: HIGGS & HILL LTD., London,

the Mersey Dock and Harbour Board, Liverpool. Manufactured by: MILBANK FLOORS LTD, GREAT WALTHAM, CHELMSFORD, ESSEX.

NOILPLY

Thames Noilply gives the smoothest surface of any shuttering entirely without oiling. This important saving in oil and labour has been achieved by facing the plywood shutter with a special glossy plastic which completely repels concrete and leaves surfaces superbly smooth. With reasonable handling Noilply shuttering can be used time and again without oiling. Later, it continues to give long service in the traditional way. The reverse side is balanced by a standard plastic. Try Noilply on your next contract and see how quickly it repays its cost.

Supplied only through trade channels.

THAMES PLYWOOD MANUFACTURERS LTD

Harts Lane · Barking · Essex · Telephone: Rippleway 5511

-

DRILLED FOUNDATIONS



Architects
Consulting Engineers
Main Contractors

Sir John Burnet, Fast and Partners Ove Arug and Partners Trailige and Calls Linesad

A modern office block which is being erected on our drilled foundations at Vauxhall Bridge Rd. London for Chesterfield Properties Limited

We have modern mobile plants which can drill foundations of various diameters up to depths of 100 feet or more. Tel: Abbey 7361 or send your enquiries to

PETER LIND

Peter Lind and Company Limited Romney House Tufton Street London SWI

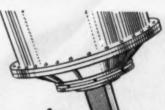


POWER BAR CUTTERS

The BRRL.50A model, illustrated above, will meet all requirements for high speed, economy, and simplicity of operation. This high-speed shearing machine will cut mild steel rods up to 2 in. diameter. It is of robust construction yet portable in view of its compact arrangement, and is powered by electric motor and self-tensioning Vee-belt drive. The moving blade is in continuous action and makes 28 cuts per minute; 2-in. diameter bars require one cut only. The static blade is housed in a specially designed seating which spreads the shearing thrust over a wide area, thus reducing wear and considerably lengthening the life of the machine. Diesel-driven machines also available. Let us send you full idetails.

CEMENT & STEEL, LTD., SECOND AVENUE, CHATHAM, KENT.

Telephone: Chatham 45580, Telegrams: Cembelgi, Chatham.



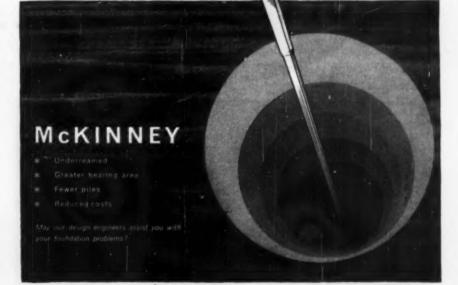
for

economy in

bored foundations

DOWN TO

110 FEET

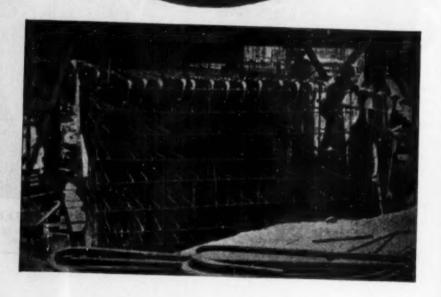


A LAING COMPANY

McKINNEY FOUNDATIONS LIMITED

Manor Way, Boreham Wood, Hertfordshire. Tel: Elstree 2854

CONCRETE AND CONSTRUCTIONAL ENGINEERING MARCH, 1961.



have been regularly used by leading Contractors for reinforced concrete work since 1903

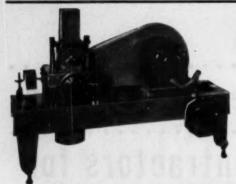
We were the pioneers in the supply of steel bars for reinforced concrete work and have given to the industry over 50 years of unbroken service, unequalled for quality and dependability. Contracts on which WHITEHEAD STEEL has been used include some of the largest and most important in the country.

We can supply mild steel with an ultimate tensile stress of 28/33 tons to the square inch, medium tensile 33/38 tons to the square inch, and high tensile 37/43 tons per square inch.

We can also supply high tensile bars 40/45 tons to the square inch with a minimum yield of 60,000 pounds per square inch.



LONDON OFFICE: Steel House, Tothill Street, S.W.I. Telephone: Whitehall 2984/5.
BIRMINGHAM OFFICE: King Edward House, New Street, 2. Telephone: Midland 0412/3.
MANCHESTER OFFICE: Chronicle Buildings. Telephone: Blackfriars 1603/4.
GLASGOW OFFICE: 50 Wellington Street, C.2. Telephone: Central 1528.



For compacting mortar cubes for compression tests to

B.S. 12/1958, 146, 1370, 915 Automatic Time Control

"CAPCO"

H.F. VIBRATOR

"CAPCO" CONCRETE TESTING APPARATUS also includes: Cube Moulds; Slump Cones; Tensile, Vicat and Cylindrical Moulds; Compacting Factor Apparatus—Standard and Automatic; Sieve Vibrators and Sieves; etc.

CAPLIN ENGINEERING CO. LTD

(ESTABLISHED 1918)

POLLEN HOUSE, 10/12 CORK STREET, LONDON, W.1
Phone: REGENT 0716. Grams: CAPLINKO, LONDON. Telex: 23255. Cables: CAPLINKO, LONDON. Works: IPSWICH.





Throughout the U.K. the Blue Circle Group of Companies has 29 cement works and 30 manufacturing plants at which are produced Blue Circle, Pelican and Dragon brands of Portland Cement, Ferrocrete, '417' Cement, Aquacrete, Sulfacrete, Hydracrete, Walcrete, Snowcrete, Colorcrete, Hydralime, Whiting, Super Snowcem, etc. It has 16 district offices and a network of distribution centres. The road transport owned by the Group includes over 1,200 vehicles for delivery in bag or in bulk, and it

operates one of the largest fleets of tugs and lighters on the Thames and Medway.

The Blue Circle Group is the largest coment manufacturing organisation in the world. You are invited to make use of its many services and profit from its great resources.

Blue Circle Products are exported to countries all over the world and the Group also has interests in twelve works overseas, nine of which are in the Commonwealth.



The Cament Marketing Company Limited,
Parcland House, Tothill Street, Lendon, S.W.I. Telephone ABBey 3456
G. & T. Earle Limited, Hull. Telephone Hull 26121
The South Wales Portland Coment & Lime Co. Ltd., Penarth, Glam.
Telephone Panarth 57301-4

GIFFORD-UDALL & GIFFORD-BURROW

Are pleased to announce following their price reductions in May, 1960 further reductions in the prices of their prestressing equipment from February, 1961.

This has been made possible by their friends at home and overseas whose loyalty in continuing to place orders at a most difficult period has enabled the turnover to be maintained and increased. Typical price reductions are shown on the opposite page.



12 wire plate anchorages 8 wire plate anchorages 12 wire tube anchorages 8 wire plate anchorages	287.6 314. 287.	27/6 18/- 30/- 27/-
PSL 7° ·276" grips complete	1/5	1/2
Model 61 15" combined jack & pump	EMS	£80
Model 61 15" independent jack	526	£58

All our products are tested by independent laboratories and our technical service which we believe the finest in the world continues to be at your service.

Experience COUNTS . .



-And behind every job...25 years' experience in the scientific repair of engineering structures

5 OLD HALL ST. LIVERPOOL 3. "HONE: CENUM 7975/6

RECONSTRUCTED STONE REPLACES NATURAL STONE



All Saints Parish Church, Leamington Spa. Architect: Rayner & Fedeski, F.R.I.B.A.

STUARTS

Established 1840

ORIGINATORS AND STILL LEADING.
WE ALSO FIX.

LONDON ADDRESS: 14 College Road, Harrow. Tel: Harrow 6161-2-3

BIRMINGHAM Northcote Rd., Stechford Stechford 3631-2 MANCHESTER Ashton Rd., Bredbury, Stockport Woodley 2677-8

EDINBURGH 46 Duff St., Don 1351-2

EXETER 6-8 Melbourne St., Exeter 73848

LACO BAR BENDING AND CROPPING MACHINES

The LGCO BAR BENDERS

are made in capacities up to 2' diameter. Several bars can be bent simultaneously.

MAIN FEATURES

Model LB.900

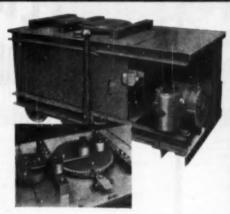
Two turntables revolve simultaneously. The fast at more than 10 r.p.m. enabling a 1" hook to be bent in 3 seconds.

Feeding: Bars are fed into the machine from left or right: hooks are made clockwise or anti-clockwise.

Automatic Stop: Turntables can be set to stop automatically at any angle to an accuracy of $\frac{1}{N}$ °.

Maintenance negligible. All bearings are ball or roller throughout. Gears are of steel and precision cut. All shafts, even the slowest, are fitted with grease-packed ball bearings.

Fitted with either electric motor, gasoline engine or diesel engine.



The LACO BAR CROPPERS

in all capacities up to 2' diameter, provide the quickest and safest method of site cropping.





Oil is circulated in closed circuit and, whilst machine is in operation, abundant positive lubrication is assured.

No damage results from lack of oil and no special servicing required. If foot pedal is depressed when no bars are placed between cutting blades, the blades will automatically stop, thereby assuring a very important safety feature because so cut can be made involuntarily. No OPERATOR HAS EVER BEEN INJURED BY THERE MACHINES. Machines available at prices lower than any other manufacturer in the World. Capacities from 1½" up to 2" diameter.

PROMPT DELIVERY AVAILABLE

Full details from

LAWLER AYERS & CO. LTD

Broad Street House, 54 Old Broad Street, London, E.C.2

Telephone London Wall 6331

TENTOR by McCALLS

FABRIC . BARS . TENTOR . BENDING . MACALLOY . DESIGN

HICALL & CO (SHEFFIELD) LTD.

HICALLS MACALLOY LIMITED

TEMPLEBOROUGH . SHEFFIELD . ENGLAND . P.O. BOX 41

Telephone: ROTHERHAM 2076 (F.B. Ex 8 lines)

LONDON: SLOANE 0428 BIRMINGHAM: ACOCKS GREEN 0229

PORTSMOUTH: COSHAM 78702

MANCHESTER: BLACKFRIARS 1018



Winget 'VIBROCON' POKER VIBRATORS

Model	Dia. Length Frequency		Ampl.		
SVO 25	1 in.	16 in.	10,000	.045mm.	
SVO 35	1½ in.	18 in.	10,000	0.70 mm.	
SVO 36V	1 5 in.	18 in.	10,000	0.90 mm.	
SVO 45	1½ in.	19½ in.	10,650	0.82 mm.	
SVO 46V	1+2 in.	194 in.	10,650	1.15 mm.	
SVO 60	2} in.	25 in.	9,600	· 1.25 mm.	
SVO 70	21 in.	27½ in.	9,000	0.82 mm.	

Petrol Engine (PDU)

Villiers Mark 12 14 h.p. petrol engine running at 2,900 r.p.m. Mounted on rubber insulators in a solidly constructed cradle. A coupling housing is mounted on the unit and within this is contained a special overrun coupling to obviate oscillations in the flexible shaft. A quick-acting locking lever allows the flexible shaft to be removed as desired. Total weight 77 ib. Petrol consumption: 14 gal. daily (average).

Electric Motor (EDU)
11 h.p. 110v. or 440v., 50 cycles 3ph. totally enclosed squirrel cage electric motor mounted on a robustly constructed steel skid. A coupling is mounted on the motor and within this is contained a special overrun coupling to obviate oscillations in the flexible shaft. A quick-acting locking lever allows the flexible shaft to be removed as desired. Total weight 85 fb.

In the Winget "Vibrocon" range, the vibratory power is at its maximum at the nose-cap end - where it needs to be - to ensure that voids are eliminated when the poker is withdrawn.

WINGET LIMITED, ROCHESTER, KENT. Tel: STROOD, KENT 7276 (8 Lines)









REINFORCEMENT

by Pashley & Trickett

Our Shefileld works is able to deal efficiently with the accurate bending of steel reinforcement for all types of construction work. We deliver clearly identified supplies to your site by our own transport, as and when you require them. Many building contractors, both large and small, are well satisfied with our service. We will deal with your enquiry promptly.



PASHLEY & TRICKETT LTD STOKE STREET, SHEFFIELD 9 TELEPHONE: 41136-7 HIGH



ALWAYS HANDSOME

PROJECTS BY

Monk

WIDE

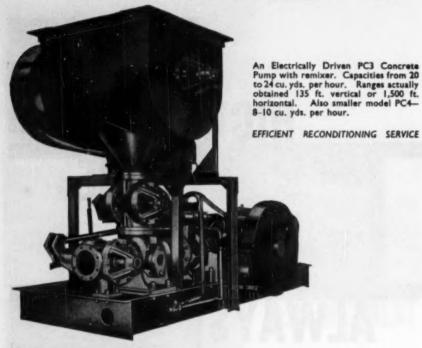


BUILDING, CIVIL ENGINEERING AND REINFORCED CONCRETE CONTRACTORS

A. MONK & COMPANY LTD
Warrington and London

Offices at:

Hull, Middlesbrough & Stamford



CONCRETE BY PUMP AND PIPELINE

- The most efficient method of placing concrete.
- Life of Pump practically Indefinite: all essential surfaces in contact with concrete are renewable.
- Pumpable concrete must of necessity be good concrete.
- Pump and Mixing Plant can be located at the most convenient position within the pumping range.
- The continuous output of the Pump at a constant speed governs the working of the whole concreting gang.

THE RESISTERED TRADE MARK OF



THE CONCRETE PUMP COMPANY LIMITED

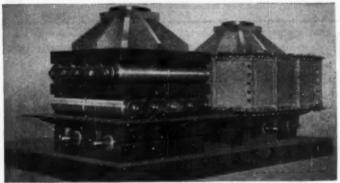
THE CONCRETE PUMP COMPANY LAD

Telephone: Western 3546

Telegrams: Pumpcret, Kens, London

Bridge Bearings



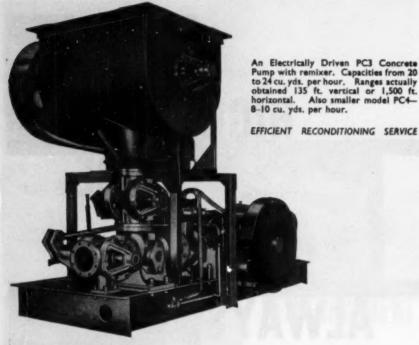


Bearings designed and constructed to suit all conditions including single, double and triple roller, expansion, hemispherical and fixed rocker bearings of which two examples are illustrated.

JOSEPH WESTWOOD & CO LTD

NAPIER YARD, MILLWALL, LONDON, E.14. PHONE: EASt 1043

Cables: Westwood, London Telegrams: Westwood, Easphone, London



CONCRETE BY PUMP AND PIPELINE

- The most efficient method of placing concrete.
- Life of Pump practically indefinite: all essential surfaces in contact with concrete are renewable.
- Pumpable concrete must of necessity be good concrete.
- Pump and Mixing Plant can be located at the most convenient position within the pumping range.
- The continuous output of the Pump at a constant speed governs the working of the whole concreting gang.

THE RESIDVENED TRADE MARK O



THE CONCRETE PUMP COMPANY LIMITED

THE CONGRETE PUMP COMPANY LTD

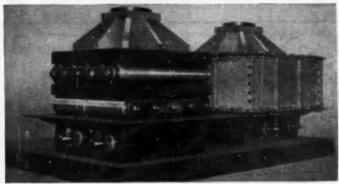
4 STAFFORD TERRACE, LONDON, W.8

Telephone: Western 3546

Telegrams: Pumpcret, Kens, London

Bridge Bearings





Bearings designed and constructed to suit all conditions including single, double and triple roller, expansion, hemispherical and fixed rocker bearings of which two examples are illustrated.

JOSEPH WESTWOOD & CO LTD

NAPIER YARD, MILLWALL, LONDON, E.14. PHONE: EASt 1043

Cables: Westwood, London Telegrams: Westwood, Easphone, London

Ensure safety with



DORMAN LONG Steel Trench Sheeting

(Regd. Design No. 850,839)

The ideal for temporary lining, easy to drive: can be used over and over again

PROMPT DELIVERY

Prices and full particulars on application to

DORMAN LONG (Steel) LTD., SHEET DEPT., AYRTON WORKS, MIDDLESBROUGH London Office: Terminal House, 52 Grosvenor Gardens, S.W.I

TOP QUALITY

FOR . BUILDING . HORTICULTURE AND INDUSTRIAL USE

THENE

Polythene Sheeting - REDUCED PR

in convenient 20 Yard Rolls

150 GAUGE-CLEAR

5/8 Roll 8/4 Roll 12/6 Roll 14/8 Roll 32" Wide. 46" Wide. 72" Wide. 84" Wide 96" Wide. 16/8 Roll

200 GAUGE-

8/4 Roll 11/3 Roll 36" Wide. 16/8 Roll 100" Wide 23/- Roll

500 GAUGE-CLEAR

21/- Roll 27/9 Roll 41/9 Roll 36" Wide. 48" Wide. 72" Wide. 96" Wide.

POLYTHENE BAGS

SPECIAL LIGHTWEIGHT 43/9 1000 49/9 1000 8 × 10 7/6 8 × 12 8/6 8 × 14 9/6 10 × 10 8/-10 × 12 9/9 10 × 15 11/-56/- 1000 | 61/3 1000 | 57/6 1000 | 62/3 1000 | 74/- 1000 | 74/- 1000 |

SPECIAL LIGHTWEIGHT 48° Wide . 5/6 Roll

10 × 18 12/-

BLACK SHEETING 48" Wide 150 Gauge . . 10/- Roll 12 ft. WIDE SHEETING

150 Gauge 20 Yd. Lengths 200 Gauge 20 Yd. Lengths 500 Gauge 20 Yd. Lengths 25/-83/6

CARRIAGE ON ORDERS

Up to £1: add 2/6 carriage Up to £2: add 3/6 carriage Over £2 add 5/- carriage

TRADE ENQUIRIES INVITED

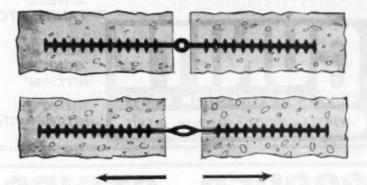
Transgrip. Exclusive device for securing Polythene sheeting under maximum tension. Ideal for Building Sites, Farms, etc. . . . 3/6 each. 6 for 18/-; 24 for 42/6; 72 for 146/-; 144 for 309/-

LARGE SHEETS UP TO SIZE

(Dept. CCEI2) 29 Victoria Road, Surbiton, Surrey. (ELMbridge 5271)

Whether it be an expansion or construction joint—let . .

DURAJOINT take the strain



See what happens when the concrete contracts.

THE DURAJOINT

retains its close keying to the concrete beyond the flange nearest the centre. No other expansion joint gives this safeguard.

It takes care of shear as well!

Sole Manufacturers

DURATUBE & WIRE LTD

CENTRAL WAY (FAGGS ROAD), FELTHAM, MIDDX Phone: FELTHAM 3453/6

* WATERTIGHT WE ARE SPECIALISTS * LININGS FOR

IN THE REPAIR * SWIMMING

AND RECONDITIONING *

OF REINFORCED*

CONCRETE STRUCTURES *

LININGS FOR **TUNNELS SEWERS** TANKS, ETC.

RESERVOIRS

POOLS, ETC.

TELEGRAMS: 'GUNITE. HITCHIN'

TELEPHONE: HITCHIN 4371

COPPER STR

All Reinforced Concrete Engineers recognise the advantages of using copper strips for sealing joints in concrete work. Copper concrete work. Copper is ductile, will not crack under repeated bending, is non-corrosive and is un-affected by wet concrete. We specialise in the supply of perforated copper strips of all required lengths and widths for expansion joints, and shall be pleased to submit prices against de-

talled specification.

HORTON STREET . FAILSWORTH . MANCHESTER

Felephone: FAILsworth 1115/6



D\$.14

35 MILLION YARDS OF CONCRETE PROVE

that ritecure

is completely reliable

. . . That's the measure of concrete cured with the RITECURE method in the British Isles alone. Or to put it another way—it has been used on over 90% of the major concrete road and runway contracts in this country. In fact, you will find testimony to RITECURE all over the world—even as far away as the Khyber Pass.

- One application of RITECURE saves labour
- · Ensures correct curing without further worry



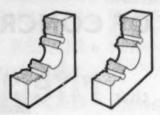
Used on the concrete section of the M.I.

Everybody knows about RITECURE, but if you want to know more, write for the free literature:

STUART B. DICKENS LIMITED

Manor Way, Boreham Wood, Hertfordshire. Telephone: ELstree 2211

HE MACALLOY END PLATE



End plates are similar (though not identical) for both wedge and threaded end anchorages and are of a size and thickness to remove any doubt about distortion under load. Two $\frac{1}{6}$ holes drilled on the diagonal $\frac{3}{2}$ apart are provided to secure the plate positively and accurately in the formwork. Using a grouting flange behind the plate, one of the holes serves as an entry for grout or an air escape hole and at the same time the flange-conveniently accepts the bar sheath to which it can be sealed without difficulty. The end plate and the grouting flange are both included in the cost of a standard end anchorage.

The standard sizes are for threaded ends:

14"	diameter	bar		6"	sq.			thick
11	29	29	(45T)	51"	sq.	I	14"	29
1-	39	39	(351)	5	sq.	X	14.	39
	39	30	(27T)	2.	sq.	x	17.	.00
and for v	redges:							
11"	diameter	bar	(55T)	7"	sq.	I	2"	.00
14"	39	39	(45T)	6"	sq.	X	2	39
1"	30	39	(35T)	5"	sq.	X	14	39

Special sizes of plates can be provided but they may of course take a little longer to produce, especially when we are very busy.

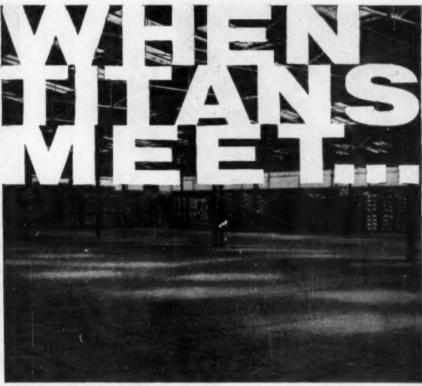


McCALLS MACALLOY LIMITED

TEMPLEBOROUGH . SHEFFIELD . ENGLAND . P.O. BOX 41

Telephone: ROTHERHAM 2076 (P.B. Ex 8 lines)

LONDON: SLOANE 0428 . BIRMINGHAM: ACOCKS GREEN 0229 PORTSMOUTH: COSHAM 78702 . MANCHESTER: BLACKFRIARS 1018



Contractors: Messrs Holst & Co. Ltd.

To render the ground floors in their new warehouse at Grimsby, hard, dustless, waterproof and able to withstand exceptionally heavy wear and tear, British Titan Products Co. Ltd., chose Lillington's No. 1 Metallic Liquid—a veritable titan amongst proofers.

From 5/- per gallon

SPECIAL TERMS FOR BULK CONTRACTORS

Write for Booklet 56

All our products now sold in free containers

For fifty years, architects have specified Lillington's No. 1 Metallic Liquid, the scientifically prepared admixture that renders concrete completely waterproof and dustless and accelerates setting time.

No. I Metallic Liquid is a necessity for waterproofing cement renderings to walls and basements, in mass concrete retaining walls, foundations, flat roofs and tanks. You can rely on it to give complete satisfaction because IT IS THE ONLY PROOFER SOLD UNDER GUARANTEE.

LILLINGTON'S

Nº 1 Metallic Liquid

GEORGE LILLINGTON & CO. LTD. WILLOW LANE, MITCHAM, SURREY

Tel: MITcham 1966

For Scotland: 42 High Street, Greenock. Tel: Greenock 20175

STEEL REINFORGEMENT

A complete service of Design, Fabrication and Fixing of Steel Reinforcement for all types of Reinforced Concrete Construction. Framemesh—High Tensile Welded Fabric to B.S. 1221 1945 Part A, supplied in Rolls and Flat Sheets.

M.S. & H.T. Bars to B.S. 785, bent, bundled and labelled, delivered to site ready for fixing. No loss of time in checking and sorting material.

T.C. JONES

ID COMPANY LIMITE

REINFORCEMENT ENGINEERS

17 Buckingham Palace Gardens, London, S.W.1. Tel: SLOune 5271, Need Office: Wood Lane, London, W.1.2. Tel: Shapherds Bush 2020, South Wate Office: Bure Screet, Cardiff. Tel: 38796, Works: Shepherds Bush, London. Neasden, Hiddox. Trearchy, Glass.



The water tower illustrated has a protective Stic B stone covering stipple finish similar to that shown in the smaller photograph. Treated in this way it is completely protected from the atmosphere and will require no further attention for many years. Stic B can

be applied direct to new or old concrete and most other building surfaces. No other material affords such lasting protection, while remaining so easy to apply.

Descriptive literature available.

STIC B PAINT SALES LTD.

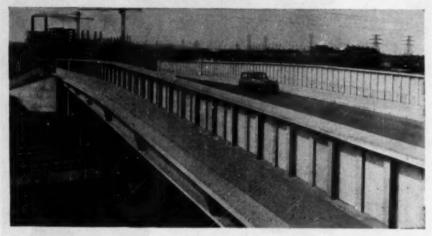
99 WANDSWORTH ROAD,

VAUXHALL, S.W.8

Telephone: RELiance 5566/2178 Telegrams: Sticbeelim, London, S.W.8



Road bridge reconstruction over railway junction - Renwick Road Bridge, Barking



Sponsor:
British Transport Commission,
B.R. Eastern Region
Consulting Engineers:
Sir William Halcrow Partners
General Contractors:
W. & C. French Limited

The Bridge at Barking, carrying Renwick Road across an area of railway track which was to form part of Ripple Lane marshalling yard, has been replaced by a bridge of greater span. The new bridge consists of two 50-ft approach spans and a central 137-ft span. The approach spans were formed from precast partially prestressed concrete inverted tee beams, placed in position, with insitu concrete added to the lower flange — stressing was then completed and concrete poured to deck level. The centre span was also of insitu partially prestressed concrete units, but was of cellular construction. 0.276 in diameter high tensile wires was used throughout and stress was applied by the Freysinnet system. The wire content of the complete project was in excess of soo.oog feet.

wire was essential-

Volmsons of course!

Richard Johnson & Nephew Limited, Manchester 11. Telephone East 1431



Our range of industrial engines are a practical proposition for many types of industrial equipment...compressors, cranes, pumps, contracting equipment, earth borers, generators, railcars, welding plant, works trucks, tractors and conversions. Simple design, modern flow-line production methods and common interchangeable parts contribute to the low cost of these high efficiency engines. And remember, every engine is fully backed by a World-wide Parts and Service Organi-

sation. Take your choice from a wide power range ... Diesel 20 to 86 b.h.p. and Petrol 11 to 87 b.h.p. (12-hr. rating).

DIESEL ECONOMY—have you considered the replacement of existing power units in your equipment and trucks with the famous 4D Diesel engine? You'll have the unique advantages of economy, long-life and low running costs... plus the best service in the World?

Wherever you are, whatever your problem,



MOTOR COMPANY LIMITED

are at your service

For further details of our

INDUSTRIAL ENGINES

and the equipment they power, send the coupon to your nearest Ford Dealer or direct to

maximum B.H.P. rec	ndustrial Engines. The
	send details of the follow
	ered by your engines.
rug eduibment bow	ered by your eligines.

Hama	40

Address	

GSI-23-3

PORD MOTOR COMPANY LIMITED - PARTS DIVISION (851) - AVELEY SEPOT - SOUTH OCKENDON - ROSSFORD - ESSEX - EHGLAHS

Expert advice and schemes submitted for gunita work of every kind. Complete information on the various uses of gunite will be gladly sent on request

116 Richmond Road, Kingston-upon-Thames, Surrey. KINGSTON 7883 and 9253

And 10 Royal Crescent, Glasgow, C.3. GLASGOW BOUGLAS MTI



Model VP 350-A (Swirel Base ilvary. Highly Competitive Prices. e-Sale Terms Available. For Greater Strength, Firmer Bonding and Better Surfacing of Concrete-

Extra-High Frequency INTERNAL CONCRETE

The model illustrated here operates at 9,000 to 15,000 Vibrations per minute from low flexible shaft speeds of 4,500 to 7,500 R.P.M.

Petrol or Electric Drive.

Robustly built throughout and backed by genuine service.

Fitted centrifugal clutch, long-life flexible drive and Vibrator.

This unique mechine, with quick-change additional tools, can also be used for: SURFACING, WET-RUBBING CONCRETE, GRINDING, DISC SANDING, AND DRILLING (up to 1) In Concrete, I' in Steel, and 2" in Wood).

Ve operate a 48-hour Shaft Repair Service for all makes. Write to-day for 8-page fully descriptive Catalogue. Agents throughout the world.

30 years' experience in the design and manufacture of flex-shaft tools.

THE FLEXIBLE DRIVE & TOOL CO., LTD.

LONDON OFFICE: 17 QUEENSBERRY WAY, S.W.J. Telephone : KENsington 3583

RHODESIA CHOSE RYLANDS WIRE

for the 163 prestressed concrete beams being used in the construction of the fly-over bridge at Beatrice Road, Salisbury. Each beam is 51' 6" long and the central point load applied by the Jack equivalent to the design load on each

beam is 8.75 tons.

— AND THIS DRAMATIC TEST SHOWS WHY

In a recent test carried out at the Salisbury industrial sites before representatives of the Government departments, the beam was mounted on concrete blocks and a hydraulic jack applied gradual pressure.

At 22.95 tons (the specified failing load) only the minutest cracks appeared.

At 40 tons the beam was still intact and at this point the test was discontinued as this was the limit of the hydraulic jacks.



Engineers: City of Salisbury.

Chief Engineer of City of Salisbury Mr. W. J. Jarvis.

Contractors: Richard Costain (Africa) Limited, Salisbury.

RYLANDS BROTHERS LIMITED

Warrington England





REINFORCEMENT SERVICE including SUPPLY & BENDING

We are manufacturers of mild steel bars for reinforced concrete, and have every facility for supplying bars cut to required lengths. We also bend ready for fixing if desired for contracts in any part of the country. Include our name on your list for future reinforcement requirements.

WALKER WRIGHT & CO. LTD

DARNALL, SHEFFIELD, 9

TELEPHONE: 41063-4-5

May we

PRECAST

your

STRUCTURAL COLUMNS

and

SAVE TIME

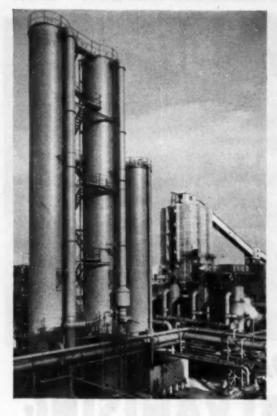
SAVE MONEY

J. A. KING & Co., LTD

181 Queen Victoria St., LONDON, E.C.4

Telephone: CENtral 5866 (5 lines)

Telegrams: Kinovique Cent London



Built for the Durham Division of the National Coal Board, this coking plant at Murton stands on nearly 1,000 "Vibro" piles. Each pile carries a working load of 55 tons.

MAIN CONTRACTORS:
Woodall-Duckham Construction
Co. Ltd.
PILING CONTRACTORS:
John Gill Contractors Ltd.

VIBRO Cast-in-place Concrete Piles

The VIBRO piling system ensures the formation of a pile consisting of dense, compressed concrete which has not been subjected to any driving stresses. The pile is adaptable in length, diameter and size of shoe to suit the ground conditions and carries its load with ample safety, yet without waste.

VIBRO piles cannot be smaller than full size, need only light reinforcement and are formed rapidly and economically. For bridges, warehouses, gas-holders, silos and similar structures imposing a heavy load on the ground, VIBRO piles provide a secure and economical foundation.

For full details write for List No. 208



TECHNICAL REPRESENTATIVES THROUGHOUT THE WORLD

THE BRITISH STEEL PILING CO. LTD.

10 HAYMARKET, LONDON, S.W.I.

Telephone: TRAfalpar 1024

RSP201



HOT DIP GALVANISING

FOR ALL TRADES

PROMPT COLLECTION Extensions to Equipment and Plant enable us to process 3,000 tons per month

PROMPT DELIVERY

CASEMENTS (READING) LTD GALVANISING DIVISION

Telephone:

READING 63211 (10 lines)

AB MOULDS

CAN BE RELIED UPON TO GIVE CONSISTENT SERVICE OVER MANY YEARS



The above illustration of a standard garden edging mould shows the tough construction of our moulds, which reduces expenditure on maintenance and constant replacement of moulds of less robust design.

A. B. MOULD & CONSTRUCTION CO., LTD.

VULCAN WORKS, VULCAN WAY NEW ADDINGTON, SURREY

Telephone: Lodge Hill 2347

Telegrams: Abmould, Croydon



12 - 12

14 - 14

16 - 16

 18×18

safest to specify STENT

Preferred by constructional engineers for their unchanging supremacy, Stent Precast Concrete Piles have proved their qualities wherever used.

STANDARD SIZES

 $12^{\prime}\times12^{\prime}$ in lengths 15 ft. to 40 ft. $14^{\prime}\times14^{\prime}$ in lengths 15 ft. to 55 ft.

Other sizes made to order.

AVAILABLE FOR IMMEDIATE

May we forward full details.

STENT PRECAST CONCRETE LTD.
Chaquers Lane, Dagenham Dock, Essex, Dominion 0971

GUNITE

WM. MULCASTER

& CO. (CONTRACTORS) LTD.

We invite inquiries for Gunite Linings and Renderings for new or old structures of every kind in any part of the country.

HASLINGTON

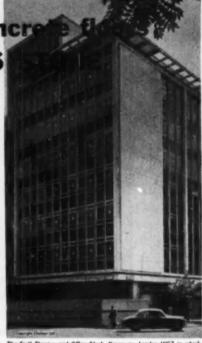
Telephone : Crewe 2265-6

CREWE

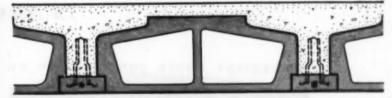
For precast concr

OMNIA FLOOR
and other types of
precast flooring

easy to handle—palletised leads quick assembly no shuttering manelithic character good heat and sound insulation fire resistant long spans and heavy leadings low weight adaptable for services economical



The Saall Theotre and Office Black, Kingsway, Landon WC2 in which the Omnie Flace was used throughout, supplied by Aclas Stone, Architect: Lewis Solomon, Koye & Portners Censulting Engineer: John DeBremosker & Partners Quentity Surveyor: Basil A. Colten, FRICS Cantractor: Taken Construction Co. Ltd.



Our skilled staff are always ready to assist you in the initial design stages or they are available to carry out the complete design work to the architect's specification.

Complete sub-contracts can be undertaken. For further information about the concrete floors write to us

The Atlas Stone Company Ltd.

Artillery House, Artillery Row, London, S.W.1. Telephone: ABBey 3081-2-3-4



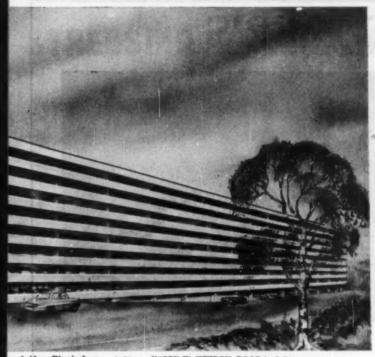
AUSTIN MOTOR COMPANY LIMITED Multi-storey Car Storage Building

THE LARGEST MULT

AT PRESENT UNDER CONSTRUCTION BY



ROBERT M. DOUGLAS (CONTRACT LONDON OFFICE: 47 V



ongbridge, Birmingham Architects HARRY W. WEEDON, F.R.LB.A. & Pa

STOREY CAR PARK WORLD

USING

RS) LTD. . BIRMINGHAM 23 . CTORIA ST, S.W.1.

STORER'S



Sawing, Planing and Moulding Hills and Storage Yards at Barking

for SOFTWOOD

Wm. T. STORER & CO. LTD.

Timber Importers and Merchants

ESTABLISHED 1913

Telephone: RIPpleway 0301 (10 lines)

RIVER ROAD - BARKING - ESSEX

STRESSING DEVELOPMENTS

LIMITED

CHANGE OF ADDRESS

Owing to expansion, as from March 1st 1961, our new address will be



FORDWATER TRADING ESTATE CHERTSEY SURREY

Telephone: CHERTSEY 2950 Telegrams: STRESS CHERTSEY

Where we welcome and give personal attention to your enquiries for:

- ANCHOR GRIPS, WIRE & STRAND
- MULTIPLE 1 STRAND POST-TENSIONING ANCHORAGES
- MULTIPLE 0.276" WIRE POST-TENSIONING ANCHORAGES
- PULL-CARRIAGE PRE-TENSIONING EQUIPMENT
- HYDRAULIC JACKS AND PUMPS
- COMPLETE STRESSING BED DESIGNS

PLEASE ASK FOR OUR NEW BOOKLET AND PRICE LIST



PUT YOUR FAITH IN THE TESTED BRAND

THIS LABEL ON EVERY BARREL CARRIES WITH IT FIFTY YEARS' EXPERIENCE OF MANUFACTURE.

NONE OTHER IS

THE LEEDS OIL & GREASE CO.

Phone 22480

LEEDS, 10 'Grams: "Grease, Leeds 10"

maximum light minimum cost

LITEX roof lights give a very high transmission of light—up to 92%—and are easily and quickly handled and fitted. A full range of standard form metal ventilators, curbs and liners are available for use with LITEX roof lights.



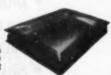
LITEX spherical roof lights

Litex

LAMINATED FIBREGLASS

roof lights

LITER roof lights with their glass fibre reinforced construction can be used with advantage in many places where conventional lights would be impracticable or too costly. Virtually unbreakable, heavy packing is unnecessary allowing quick and easy handling on site.



LITEX rectangular roof lights

LITEX roof lights are ideal for use in schools, hospitals and other buildings where absolute safety is required—they will not shatter and cannot support combustion. The plastic will not creep, nor become brittle with age or very hot temperatures.



LITEX roof lights are not attacked by smoke or fumes from most industrial processes, and may safely be used in factory and workshop buildings.

For further information about LITER roof lights please write to

LITEX lantern lights

LENSCRETE LIMITED Queens Circus London SW8 telephone MACaulsy 1063

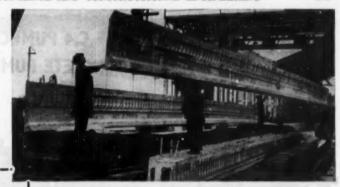


Illustration above shows some of the post-stressed bridge beams, each 80 ft. long and weighing 35 tons, produced by Anglian Building Products Ltd., for British Railways, Midland Region. Main Contractors: Messrs. Leonard Fairclough Ltd.

80-ft. BEAMS cast in OODEN

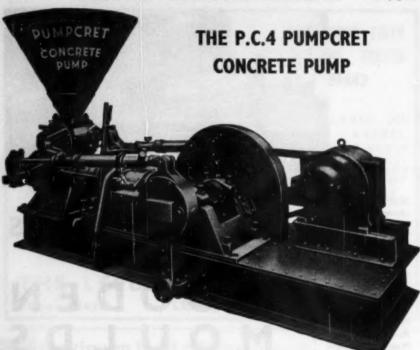
supplied by

Y & BUT

SPECIALISTS IN TIMBER SHUTTERS AND MOULDS FOR CONCRETE

More and more Contractors and Precast Concrete Makers in all parts of the country are taking advantage of the first-class service we offer in the supply of timber shutters and moulds to any design and size. This service has proved over and over again that by ordering your shutters and moulds from us you effect every possible saving in time, labour and money. However intricate the shutter or mould, you are assured of accuracy in every detail and a product with long trouble-free life. Shutters and moulds can be supplied with a plastic lining if desired. Full details of this class of work carried out by us are available on request.

HEYBRIDGE BASIN, MALDON, ESSEX. TELEPHONE: MALDON 499/9



CONCRETE BY PUMP AND PIPELINE

Specifications:

Two Sizes	P.C.3	P.C.4
Capacities per hour, approx Range:	20-24 cu. yd.	8-10 cu. yd.
Horizontal, approx	1500 ft.	1250 ft.
or Vertical, approx	135 ft. 6" i.d.	125 ft.
Power required: Electric or Diesel	45 h.p.	41 i.d. 25 h.p.

FOR HIRE



THE REGISTERED TRADE MARK OF

PUMPCRET HIRE COMPANY LTD

4 STAFFORD TERRACE, LONDON, W.8

Telephone: Western 3546.

Telegrams: Pumpcret, Kens, London



BUILD ON A SURE FOUNDATION

The modern piling techniques and systems of Simplex are backed by over half a century of experience. Schemes and quotations for piling or reinforced concrete foundations will be gladly supplied, without obligation, on request.



Palace Chambers, Bridge Street, Westminster, London, S.W.I. Tel: TRAfalgar 1167/9

1

WOOD

for PRECASTING

EXTREME ACCURACY

ALL TYPES ALL

25 years' experience at your service

ARCHITECTURAL SPECIALISTS
AND MODEL MAKERS

LAWS & SON (STAINES) LTD

(CONTRACTORS TO H.M. GOVERNMENT)
Langley Road Works, Staines, Middx

Telephone: Staines 53700

and

Pottery Lane, Newcastle-on-Tyne

Telephone: Newcastle 20567

SCHMIDT



CONCRETE TEST HAMMER

for immediate non-destructive determination of compressive strength

O. A. VOLKMANN

3 ST. AUGUSTINE'S ROAD, BIRMINGHAM, 16

Telephone: Edgbeston 1353

A "CONCRETE SERIES" BOOK

REINFORCED CONCRETE RESERVOIRS AND TANKS

By W. S. GRAY

FOURTH EDITION 1960

Revised by G. P. MANNING, M.Eng., M.I.C.E.

This book has been extensively revised to include the up-to-date methods of design and construction of open and covered reservoirs, tanks on or below ground, swimming pools, and gas-holder and tar tanks.

Charts relating to the new British Standard Code of Practice No. 2007 (196c) are given.

As in previous editions, Dr. Reissner's method of calculating the bending moments on the walls of cylindrical tanks is given in full.

Many examples with working drawings and illustrations and practical notes on construction are given.

190 PAGES

Price 12s.; by post 13s.

2.80 dollars in Canada and U.S.A.

CONCRETE PUBLICATIONS LTD.

14 DARTMOUTH STREET, LONDON, S.W.I



HUMDINGER

RELIABLE high-frequency vibrators



SLOW SPEED DRIVE:

FLEXIBLE SHAFT RUNS AT 2,050 R.P.M. LESS MAINTENANCE LASTS LONGER

12,000 VIBRATIONS PER MINUTE:

THOROUGH COMPACTION OF COARSE MIXES. HIGHEST DEGREE OF DENSITY

INTERCHANGEABLE HEADS:

1" DIA. × 25" LONG 11" n × 22" n 24" n × 191" n 3" n × 15" n

USEFUL ACCESSORIES:

GRINDING AND CLEANING TOOLS FOR A VARIETY OF USES

OTHER MODELS IN THE POPULAR RANGE OF ACE CONSTRUCTION EQUIPMENT. "Skymaster

Mk. II"—Man-carrying hoist. "Loadmaster"— Concrete Elevator. "Bomag"—Vibrating Rollers. "Comet"— Mobile Hoist. "Dalli"—Handscraper. ACE SERVICE: "Service to the Customer", that's the key phrase of the ACE Service Department, unrivalled for its courtesy, efficiency and speed.

The phetograph used in this advertisement was taken by kind permission of W, J, Binms, Bone is Conba Limited.



A.C.E. MACHINERY LIMITED

GLASS FIBRE

FLOORING

SPIRAL STAIRWAYS

PANELLING

COLUMNS

ALL YOUR MOULD PROBLEMS SOLVED



D. A. MODELS

LTD

108 WOODSTOCK ROAD LONDON W.4
TELEPHONE: CHISWICK 2011

FOUR OUT OF FIVE LARGE

Strand

contracts in the U.K. use CCL anchorages

E 12" Spiral anchorages

CCL Spiral Anchorages are used extensively, both at home and overseas, due to their advanced design and reliability undersite conditions. These allmetal, embedded type anchorages provide additional safety against bad concrete compaction.

For helpful advice or technical information write to:



CABLE COVERS LIMITED · St Stephen's House · (Technical Service Dept) · Westminster S.W.1

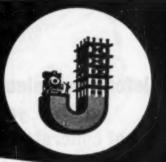
RANALAH for STEEL MOULDS

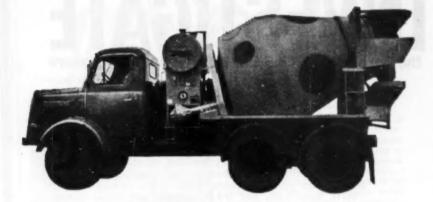


Phone
BRIGHTON 62216-7-8-9
for IMMEDIATE ACTION

RANALAH STEEL MOULDS LTD LOWER BEVENDEAN · BRIGHTON · SUSSEX







Available in several capacities, either with petrol or Diesel engine or power take-off.

Quick and intensive mixing.

Quick charging and discharging.

DE

ONG

HAZERSWOUDE HOLLAND

P.O. Box 88 LEIDEN

Over 40 years' experience in the construction of contractors machinery.

Before you place another yard of concrete



INVESTIGATE

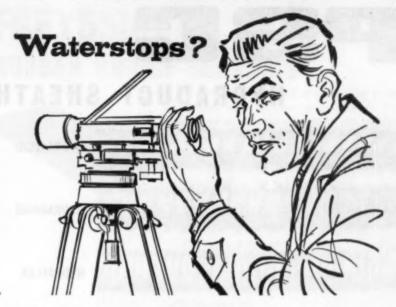
the economy of C.P.O.A.C. Placy pneumatic placers

A remarkable feature of to-day's building industry is the large number of builders and contractors who still place concrete with such outdated equipment as barrows, hoists, buckets and shovels. Not only are these methods a waste of costly man hours, they are also downright inefficient, if we may be pardoned for saying so. No other method of concrete placing is so economical, so sure, so trouble-free, as piping it by the C.P.O.A.C. Placy. One Placy machine, operated by one man will transport from the mixer to the spreading gang, more than 120 cu. yds. of concrete a shift! The serving radius is 1000 ft. horizontally and 180 ft. vertically and round corners. There are no working parts to seize up or wear out and maintenance therefore is negligible. Why not see the C.P.O.A.C. Placy in action, its sheer efficiency will astound you. We shall be pleased to demonstrate it to you

Manufactured in Gt. Britain and Distributed by

MACHINERY (CONTINENTAL) LTD.

2 Park Street, London, W.I. Telephone Hyde Park 1401





The Now Underpass, Hook Road constructed by William Old Limited for the Surrey County Council

Expandite Limited produce a complete range of efficient Rubber and PVC Water-stops for every type of joint. Made in various designs and lengths, they are accepted as being the most effective and economical method of ensuring watertight structures.

Expandite Waterstops are specified by architects the world over because, unlike metal waterbars, they are not subject to corrosion and will not fracture with movement.

Not content to rest on their laurels, Expandite are constantly introducing new developments. The HYDROFOIL (PVC) revolutionary design combats all seepage, and is suitable for walls, floors, reservoirs, sewage works, ponds, etc. where limited movement may occur.

If you need advice on any problem concerning Waterstops and their most effective use, the Expandite Technical Service Department is always at your service. Please contact us.



CHASE ROAD, LONDON, N.W.10. Tel: ELGar 4321 (10 lines) Telex 25420 ELGar 1551 (10 lines)

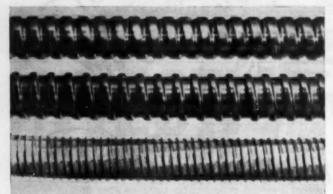
Trafford Park Road, Manchester 17 Telephone: Trafford Park 1285/6 36 Great North Road, Newcastle-upon-Tyne 2 Telephone: Newcastle 23992

Eire: EXPANDITE (IRELAND) LTD., Greenhills Road, Walkinstown, Dublin Telephone: 501512

ASSOCIATES AND DISTRIBUTORS THROUGHOUT THE WORLD

PSC

HYDRADUCT SHEATH



HYDRARIGID

HYDRARIGID

HYDRAFLEX

Hydraduct is an extremely robust form of sheathing for prestressing tendons and meets the most stringent requirements of Designers and Contractors; problems which may be encountered in transportation and site handling have been carefully considered.

PSC GROUT INJECTION EQUIPMENT



 P.S.C. hand-operated disphragm, direct displacement grout pump with electrically operated stirrer.



P.S.C. power-operated grout injection pump.

The subject of cable grouting is one that P.S.C. Equipment Limited have studied intensively and for which a range of equipment has been developed.

PIONEERS OF PRESTRESSED CONCRETE IN GREAT BRITAIN

P.S.C. Equipment Limited, members of the Freyssinet International Organisation, have available a range of prestressing systems including Freyssinet MultiWire, Freyssinet MultiStrand—FreyssiStrand, P.S.C. MonoWire, P.S.C. MonoStrand and P.S.C. Pretensioning. Full details and complete technical information are always available on request.

FREYSSINET RUBBER BRIDGE-BEARINGS



. . . the modern method of supporting bridges and other civil engineering structures. They are more economical and technically superior to traditional steel bearings and are widely recommended. Freyssinet bearing pads are of unit bonded construction. The design of the pads is based on the relationship between loads, displacements and rotations, and, as no moulding is required, each case is treated as unique and the proposed pad calculated accordingly. The highly satisfactory behaviour of this type of pad has been proved by tests and by observation on over 500 bridges on which they have been used. Technical questionnaire forms are available on request.

FREYSSINET FLAT JACKS



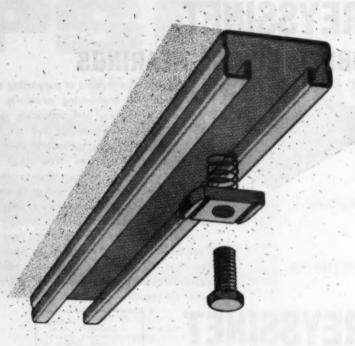
Ref.	Outside Diameter (inches)	Maximum Force (tons) at 2,000 lb./in.*
07 12 15 22 25 27 30 35 42 48 60 87 92	2-75 4-72 5-90 8-66 9-84 10-6 11-8 13-8 13-8 13-7 23-6-5 19-7 23-6-2	3 9 17 41 54 64 81 114 168 245 357 777 772 866

These hydraulic jacks of unusual and unconventional design permit enormous forces to be exerted where the movement required is small. They have considerable application in underpinning, levelling, and thrust control in engineering structures.





HEAD OFFICE AND WORKS: ARUNDEL ROAD, INDUSTRIAL TRADING ESTATE, UXBRIDGE, MIDDX
Talephane: Uxbridge 35241



NEW UNISTRUT PRE-CAST CONCRETE INSERT

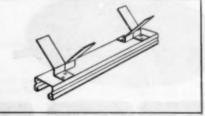
This new Unistrut component supplements the already wide range of Unistrut concrete inserts. Designed specifically for use with precast reinforced concrete slabs or planks, where the channel is not cast in flush with the surface, only the fish tail lugs being embedded.

These new inserts are quicker to position, more adaptable and more economical in was whilst retaining all the advantages of the Unistrut steel channel framing system . . . any Unistrut 'sperialist use' com-ponents being used in conjunction with them.

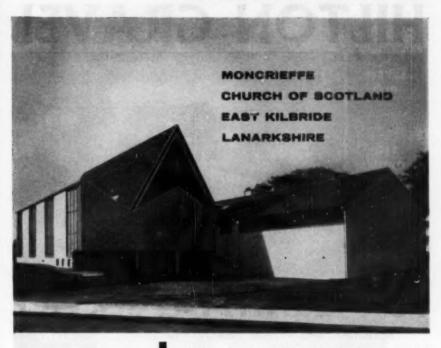
Finish is in green stove enamel or gal-vanised. For drawings to bring your parts catalogue up to date or for details of this new component write to:

UN1/1116

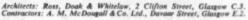




UNISTRUT DIVISION OF SANKEY-SHELDON LTD., 43/45 Broadwater Road, Welwyn Garden City, Herts. Tel: Welwyn Garden City 6321 (4 lines) 'PUDLO' PROVIDES PROOF . . . No. 4 OF A SERIES



When this fine church was built 'Pudlo' Waterproofer was used in all cement work below ground level. Mix: 5 lb. 'Pudlo' to 1 cwt. cement.



Quietly and efficiently 'Pudlo' cement Waterproofing Powder plays its part in all manner of building projects throughout the world—from underground reservoirs in Gibraltar to mansion blocks in Hong Kong, from power stations in Europe to the modern church illustrated above. For more than fifty years 'Pudlo' Brand Waterproofer has maintained its reputation in the most searching conditions. 'Pudlo' can be used either to retain or exclude water in all types of concrete structures; our technical service is at your disposal and free advice may be had on any individual waterproofing problem.



The word 'PUDLO' is the registered Trade Brand of Kerner-Greenwood & Co. Ltd., by whom all articles bearing the Brand are manufactured.

CEMENT WATERPROOFING POWDER

OTHER 'PUDLO 'PRODUCTS INCLUDE: Waterproof Cement Paints, Cement Paint Primer, External Water Repellent, Cement Bonder, Plaster Bonder, Frost Protector/Rapid Hardener, Mortar Plasticiser, Cement Hardener/Dust Proofer, 'Feusol' Fire Cement. Concrete Plasticiser and Permanent Colours for Cement.

KERNER-GREENWOOD & CO. LTD. KING'S LYNN, NORFOLK

WT.19

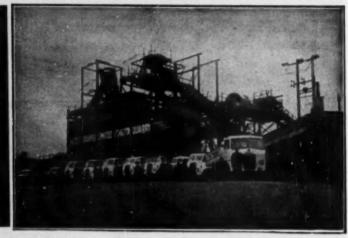
Telephone: King's Lynn 2293

HILTON GRAVEL

SEVEN

LORRIES

8,000 TONS PER DAY



FOR QUALITY & SERVICE

REGULAR DELIVERIES THROUGHOUT

STAFFORDSHIRE

CHESHIRE

DERBYSHIRE

NOTTINGHAMSHIRE

WEST RIDING

LANCASHIRE

SHROPSHIRE •

WARWICKSHIRE

LEICESTERSHIRE

RUTLAND

The illustration above shows one of our seven pits equipped with the most modern washing and grading plant for producing concrete aggregates that will satisfy the most exacting requirements for cleanliness and grading to specifications.

READY MIXED CONCRETE

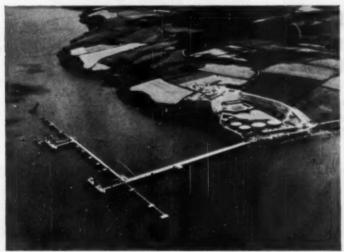
20 miles radius MANCHESTER

From our Plant at RICE STREET MANCHESTER 3

DEAnsgate 5455

HILTON GRAVEL LIMITED
HEAD OFFICE: HILTON, DERBY, Tel: ETWALL 422

CHRISTIANI & NIELSON LTD CIVIL ENGINEERS & CONTRACTORS



BP Trading Ltd., Marine Terminal, Milford Haven. Consulting Engineers: Rendel, Palmer & Tritton.



A WORLD-WIDE ORGANISATION ESTABLISHED 1904

ROMNEY HOUSE - TUFTON STREET - LONDON S.W.I

Telephone: ABBey 6614/7 Telegrams: Reconcret, Sowest Telex No. 2-2395

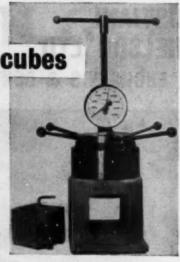
concrete cubes on site MILBANK-WELLS

HYDRAULIC PRESS AND CUBE MOULDS

Immediate Delivery

Two Sizes: 4 in, and 6 in.

PRESSES and CUBE MOULDS Testing to 16,000 lb. per sq. in, to B.S. 1881.



Approved for all Government Contracts

IN USE ALL OVER THE WORLD

6-IN. PRESS 258 TONS

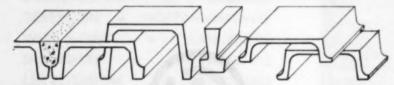
4-IN. PRESS

MILBANK FLOORS LTD

PRESTRESSED CONCRETE CONSTRUCTION

MIVER HOUSE, EARLS COLNE, ESSEX

Telephone: Earls Coine 410



PRESTRESSED FLOORS & ROOFS SPANS UP TO 40 ft FRAME BUILDINGS ALL TYPES



SINGLE SPAN . MULTI SPAN . CANTILEVER

Sealocrete Sealocrete

makes the best concrete ...

Sealocrete Air Entraining Agent in concrete mixes

IMPROVES flow, compaction and impermeability of concrete; resistance to sulphate and
freet ettack; pumping without correction:

frost attack; pumping without segregation; coverage of reinforcement; density and smoothness; workability; riding qualities of concrete roads.

REDUCES water-cement ratio; vibrating and placing time by half; segregation and bleeding; wear on mixing and placing plant; green breakages and gives sharp corners; manufacturing costs.

SEALOCRETE PRODUCTS LIMITED

ATLANTIC WORKS · HYTHE ROAD · LONDON N.W.10
Telephone: Ladbroks 0015/P.B.E.
Telegrams: Sealocrete, Wesphone, London

Cables: Sealocrete, London



Only the best is good enough SELSET RESERVOIR FOR TEES VALLEY AND CLEVELAND WATER BOARD

Concrete incorporating Sealocrete Air Entraining Agent pumped approximately 1200 feet through re-mixer up hillside.

Contractors: Balfour Beatty & Co. Ltd.
Consulting Engineers: Edward Sandeman.

Kennard & Partners.





Land-Rover owned by Mesors. Higgs & Hill working in connection with the new Slough—Maldenhead by-pass

Today's Land-Rover and tomorrow's roads

Fine new roads to take the ever-increasing load of Britain's traffic . . . and helping to build them, the 4-wheel drive Land-Rover! Land-Rovers fetching, carrying and hauling men and materials . . . riding easily over vicious surfaces that will become tomorrow's motorways. Tough, reliable constructive Land-Rovers. Ask your Distributor or Dealer for a Land-Rover Demonstration.



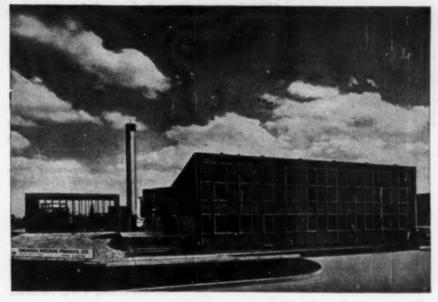
There's no substitute for the 4-wheel drive



Petrol or Diesel

By Appointment to liter Majority Queen Elizabeth IT Majority or Land-Rosery

THE ROYER COMPANY LTD - SOLIHULL - WARWICKSHIRE also DEVONSHIRE HOUSE - PICCADILLY - LONDON CVI-277



OUTSTANDING BUILDING...

Outstanding products

CHEMICAL BUILDING **PRODUCTS** LIMITED Warple Works Cleveland Road Hemel Hempstead Herts.

PROLAPIN Liquid Cement Waterproofer LITHURIN Concrete Floor Hardener

QUICKSOCRETE P.Q. & D. Rapid Hardeners and Setters WETEXI 'S' Colourless Silicone Waterproofer

CONPLAST Concrete Plasticiser CONPLAST 'W' Anti-freeze and Plasticiser CEBEX 112 Mortar Improver

CEBEX 113 Expanding Grouting Material CEBEX 124 Multi-purpose Slurry Liquid ROAD CONPLAST Air Entrainer and Plasticiser

CONBEX Plasticised Expanding Grouting Material

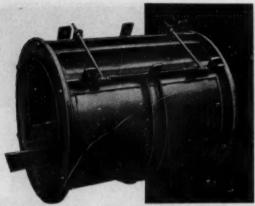
CHEMICAL BUILDING PRODUCTS LTD

Telephone: Boxmoor 4900 (5 lines) Telegrame: Prolithu Hernel Hempstead

We shall be pleased to supply full doscriptive literature.

LIFTOYL Floor Cleaner and Degreaser ORKIT & TEKTAM Bituminous Coatings and Compounds

CONCURE Concrete Curing Agent NITOLUX & ROBRITE Paints



Side filling moulds for manufacturing 24" diameter by 3' effective length O.G. pipes.

Further details and quotations sent on request

Moulds and formwork

for the concrete industry

A service to the industry ranging from the small equipment illustrated to complete spinning plants, backed by years of technical experience.

We are now operating from our extensive new premises at the address below.

Coneybeare

THE ORIGINAL PIPE MOULDS

Coneybeare & Co. Ltd., Torrington Road, Ashford, Kent. Tel: Ashford 1545/6

Best Quality

CONCRETE AGGREGATES

in all grades

DELIVERED BY ROAD OR RAIL

MEMBERS OF S. & G.A. of G.B.

ESTABLISHED IRIO IRONGATE WHARF, PADDINGTON, W.2 TELEPHONE: PADDINGTON 2024-6



rent Gravels 10.000 tons per week

Washed & Crushed 11 in. to 1 in.

We are the leading suppliers of high-class concrete aggregates in the area shown above. Prompt deliveries guaranteed and keen competitive prices quoted. Sand for samples and prices

TRENT GRAVELS LTD

ATTENBOROUGH
Telephone: Nottingham 25-4255

"CONCRETE SERIES"

CONCRETE PUBLICATIONS, Ltd. 14 Dartmouth St., London, S.W.I



For the Forth Road Bridge Joint Board.
Consulting Engineers: Mestrs. Mott, Hay and Anderson. Contractors: John Howard & Co. Ltd.

FORTH

ROAD BRIDGE

CONCRETING S A N D

FOR THIS IMPORTANT CONTRACT WAS SUPPLIED BY

SAND& GRAVEL CO., LTD.



We are one of the leading suppliers of concrete aggregates in Scotland, and can supply at short notice, from our pits at Blairgowrie, Crieff, and Daimally, Washed Concreting Sand to B.S. 882/1954, Washed and Graded Gravel, Building Sand, Fine Sand, and Filter Media and Dried Sand in any desired quantity.

Let us send you samples and prices for your next contract in our delivery area shown here.

EAST CAMPERDOWN ST . DUNDEE . TEL: 82211

INSEPARABLE from REINFORGEMENT



OF COURSE!

the specified concrete cover is accurately maintained . . .

Complying in ALL respects to the British Standard & Codes of Practice. The U-KLIPON BAR SPACER of revolutionary design is instantly fixed with a vice-like grip in the desired position on all types of reinforcement, including mesh and prefabricated. As an inseparable part it positively cannot be displaced by heavy tamples or vibrating. For any Ser Spacing problem,

CONSULT

THE B.E.C. BAR SPACER SERVICE

which has been and is responsible for the most outstanding and prominent contribution to accurate har spacing in reinforced concrete, thus providing practition, economy, and labour-saving means of onsuring that the specified concrete "cover" is maintained under all conditions. It is noteworthy that such is the increasing popularity and demand for "B.E.C." Bar Spacers, borne out by sales in excess of 35 millions, that we are able to RETAIN OUR PRICE LIST OF 945 WITHOUT MODIFICATION. Over 120 stocks sizes of bar spacers enable us to give immediate attention to requirements. Write now for comprehensive details and samples. Our Technical Consultants will call on request.

Patent Nos. 597,505, 715,563, 789,018, 818,538.
Registered Nos. 870,560, 886,239. English and foreign patents pending.



B.E.C. BEARER BLOCK FOR GROUND BEAMS · BARREL ROOFING BRIDGES · MAT WORK · ETC.

The "B.E.C." precision-made bearer block is another inexpensive B.E.C. aid to obtain accuracy with speed in concrete construction. Let us send you full details.

BERRY'S ENGINEERING CO.
SOLE MANUFACTURERS:

Middle Road, Shoreham-by-Sea, Sussex Phose and Grame: Shoreham-by-Sea 3441-2 CONTRACTORS TO MINISTRY OF SUPPLY, ETC., ETC.

Enhance your Prestige. Specify and use with confidence.

THE GAMMON-MORGAN

for the ACCURATE. SIMPLE AND

measuring of the WATER CONTENT IN SAND

The most accurate, simple, and rapid means of measuring the water content in the sand. No weighing or chemicals are required, and an adequate sample is used. The GAMMON-MORGAN WATER-IN-SAND ESTIMATOR should be available alongside every mixer, so that the water content of every mix may be correctly gauged. Full details will be sent on request.

PRICE (3 10s. each (10 Canadian or U.S. dollars). CARRYING CASE £1 15s. (5 Canadian or U.S. dollars).

WATER-IN-SAND ESTIMATOR

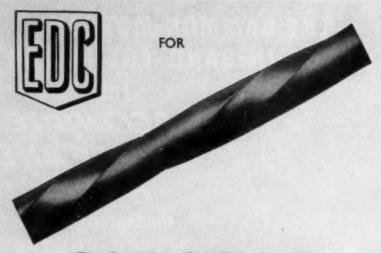
MOISTURE VARIATIONS IN THE SAND

Engineers should specify that the concrete mix shall be adjusted for moisture variation in the sand, so that the total water in the batch shall consist of the water carried in the aggregates plus the water added in the mixer.

COLCRETE

GUN LANE · STROOD · KENT

Phone: Strood 78431/2/3



COROBAR

THE COLD WORKED BAR

CONCRETE REINFORCEMENT

FOR DESIGN, SUPPLY, BENDING & FIXING OF MILD STEEL BARS, COLD WORKED BARS AND HIGH-TENSILE WELDED FABRIC

THE ENGINEERING DESIGN & CONSTRUCTION COMPANY LIMITED

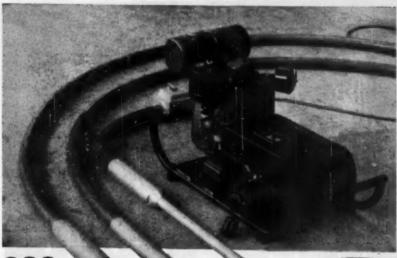
REINFORCEMENT SPECIALISTS

OFFICES: ARDSHIEL HOUSE EMPIRE WAY WEMBLEY, MIDDX.

TELEPHONE: WEMBLEY 9474

WORKS: RIGBY LANE
HAYES, MIDDX.

TELEGRAMS: EDCON, WEMBLEY



cycles INTERNAL VIBRATORS without flexible drives

Now fitted with overload and anti-single-phase switches.

This new internal vibrator dispenses with the use of flexible drives. It has a frequency of 12,000 r.p.m. which, combined with amplitude, provides exceptional compaction of very harsh mixes. Vibrators of varying sizes, together with single- and multi-tool generators (Petrol, Diesel, and Electric drives), make this the most versatile range of internal vibrators so far available. It is in full production, and has already proved of considerable value to Contractors, Builders, and Precast Concrete Makers. Complete details of these and the range of Allam Vibrating Equipment will be sent on request.

E.P. ALLAM & CO. LTD.

LONDON: 132-135 Sloane Street, S.W.I. . Telephone: Sloane 9976 (5 lines)

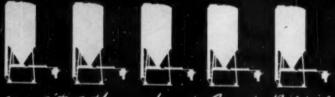
Works: Southend-ro-Ses Tel.: Eurorood \$25343

AGENTS & DISTRIBUTORS: Strangford Ltd., Beifest and Dublin; A. Gunn & Co. Ltd., Altrincham, Ches.; O. L. Davies Ltd., Port Talbet, Cleam.; L. Lewis (Pachinary) Ltd., Bortlem, Sahk-on-Trent; Concrete Engineering Services, York Road Industrial Estate, Watherby, Yorks; John Residence Ltd., Newszed-on-Tyre; W. R. Sahroed, Ltd., Chandler's Ford, Seuthempun; J. A. PfcAre & Co. Ltd., Glasgee; Pledern Plant Sahe Ltd., Ordeary, Burningham.

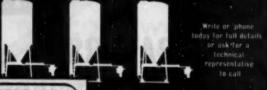




Thousands of Portasilos



on sites throughout Great Britain

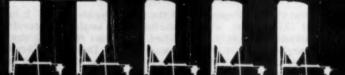




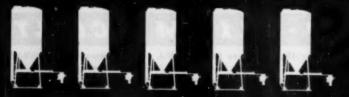
PORTASILO

Home Sales Office: LAWRENCE ROAD GREEN, LANE.

HOUNSLOW MIDDLESE



The most popular portable bulk cement sile in the world



CONCRETE

CONSTRUCTIONAL ENGINEERING

INCLUDING PRESTRESSED CONCRETE

Volume LVI, No. 3.

LONDON, MARCH, 1961.

EDITORIAL NOTES

Statically-indeterminate Structures.

ATTEMPTS to avoid the complexity of rigid analyses of statically-indeterminate structures has led to the production of many methods which are easier to apply and the results of which are of sufficient accuracy for the purpose of structural design. The two principal classes of analyses are those in which the elastic condition at working loads is investigated and those based on the behaviour of the structure as the condition at failure is approached. The latter class include the ultimate-load theories which have gained acceptance only in recent decades and for which the virtues of comparative simplicity and realism are claimed. The former class includes the several classical analyses which were developed

during the period dating from a century or more ago.

Many of the elastic theories and methods of analysis fail to take into account the characteristics of the materials of which the structure is to be constructed. The early elasticians, and some of their successors, assume they are dealing with an ideally elastic material and, although steel may conform as near as matters to such a material and prestressed concrete likewise, reinforced concrete definitely does not do so. Most elastic analyses take into account the mis-named moment of inertia (or second-moment of the area) of the cross-section of the structural member, or at least comparative moments of inertia. This geometrical property of a reinforced concrete member is not readily or accurately determinable. It is necessary only to consider such a case as a column, which may be entirely in compression, combined with a tee-beam which has a flange not only of an indefinite width but, if tensile stresses occur in the flange, liable to an indefinite degree of cracking if any. Also the effect on the stresses and deformations of such phenomena as shrinkage, creep, and "built-in" strains are rarely taken into account even if it were possible to do so realistically. The common assumption of a loaded frame being a planar assembly of members ignores the effect of adjacent and less highly loaded members in relieving to some extent the loaded frame. The relation between the elastic theory of structural action and the behaviour of engineering structures was the subject of the James Forrest lecture delivered last month by Professor A. J. S. Pippard at the Institution of Civil Engineers.

From time to time attempts have been made to correlate theoretical with actual behaviour of concrete structures. One of the objects of the Symposium

on the Strength of Concrete Structures held in London in 1956 was to establish such correlation, and one of the principal outcomes of these discussions, and other attempts at correlation, is the support given to ultimate-load or plastic-hinge theories. To-day these theories are being carried a stage further in so far that the practical aspect is being given prominence in the development of methods of analysis. In particular, the efforts being made by the Commission for Hyperstatism of the European Committee on Concrete (Comité Européen de Béton) to correlate theoretical and actual behaviour are noteworthy. Elsewhere in this number, Professor A. L. L. Baker, who is the Chairman of the Commission, gives the basis of a general equation for the ultimate-load analysis of frames taking into account the inelastic deformations. At the meeting of the Committee in Monaco in January last, this equation and a simplified limit equation were, with little modification, accepted.

The evolution of the general equation results from the discussions of the Commission. Previous proposals include an approximate theory, a moment-distribution method, a precise method for continuous beams and a limit method. The general equation is applicable without difficulty to simple frames and continuous beams but other methods, such as a limit method with simplifying assumptions, may be more suitable for frames which are many times statically indeterminate. It is possible that eventually the general equation will be extended to

three-dimensional frames.

The application of the general equation depends on the availability of momentrotation diagrams for common typical sections and distributions of bending
moments with or without direct load. Practical tests, the object of which is to
obtain this data, are proceeding in several laboratories in different countries as
part of the programme of research co-ordinated by the Commission. The more
research is directed to this subject, the more comprehensive will be the data
acquired. To this end, this journal is pleased to accord with the request of the
Chairman of the Commission by announcing the Commission's invitation to

suitable laboratories not yet taking part to share in this work.

The programme of tests as organised by the Commission is comprehensive but flexible. Three qualitites of concrete are considered having cylinder crushing strengths of 2850 lb., 4300 lb., and 6000 lb. per square inch respectively; if after preliminary tests it is thought that the strength of the concrete is not an important factor, all tests would be made with concrete of the intermediate strength. Four qualities of reinforcement are to be used, namely, mild steel bars, cold-worked smooth and deformed bars, and ordinary high-tensile bars. The effect of binders in over-reinforced beams and in members in which compressive stresses only occur is also to be investigated. The specimens being tested are to be subjected to bending only, to bending and compression with tension reinforcement and with tension and compression reinforcement, to a central concentrated load, and to loads at the quarter-points. Members having various ratios of span to depth are to be tested but, for the time being, the tests are to be limited to members of rectangular cross-section. The countries participating at present are France, Germany, Great Britain, Italy, Russia and the United States of America. The laboratories in each country are allocated a range of variations; for example, in Great Britain, the tests will be made on the strongest concrete with mild steel reinforcement. The number and range of the variants are most extensive, but



it is expected that early tests with extreme parameters will enable a practical range to be determined and so reduce the amount of investigation.

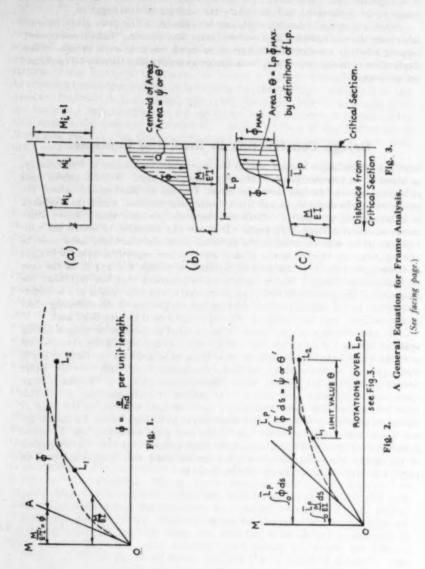
Such widespread research work can be valuable if the tests made by each laboratory are co-ordinated by a central body, thus avoiding that extensive overlapping which is a lamentable feature of so much research work to-day. Some duplication of investigation may be desirable as results may thereby be confirmed (or otherwise).

Bridge Construction in Steel and Concrete.

SEVERAL of the larger bridges now in the course of construction in this country, or about to be commenced, are primarily steel structures. Notable among such structures are the bridges over the River Thames at Maidenhead, where the steelwork will be exposed, and at Runnymede (near Staines), where the steelwork is to be encased in concrete. Both structures are provided with massive abutments of concrete faced with brick. It is not the intention to revive the controversy which was reported in the national press and elsewhere some months ago regarding the relative merits of steel and concrete superstructures for bridges of these spans (270 ft. in the case of Maidenhead Bridge and 174 ft. in the case of Runnymede Bridge), but it cannot go unremarked that the fact that the steelwork of Runnymede Bridge is to be encased in concrete results in a considerable saving in the amount of steel required mainly because of the stiffening effect of the concrete, and this saving is effected in spite of the extra dead load.

No such controversy can, however, be justified in the case of bridges having spans of several thousand feet such as the road bridges now under construction over the River Tamar (span 1100 ft.) near Plymouth, and over the Firth of Forth (span 3300 ft.) in Scotland, or the bridges proposed to be built over the River Severn (span 3240 ft.) and the River Mersey (span 4500 ft.). For such large spans, steel suspension structures are, at present at least, the only practicable type but, for the tall piers required for such bridges, concrete in the form of reinforced concrete in the case of the main piers 240 ft. high for the Tamar Bridge and prestressed concrete in the case of the side piers extending 150 ft. above high water for the new Forth Bridge is the most suitable material. A description of the design and construction of the piers for these two bridges is given on

pages 130 and 105 respectively of this journal.



96

A General Equation for Frame Analysis.

By PROFESSOR A. L. L. BAKER, D.Sc.(Eng.), M.I.C.E., M.I.Struct.E.

The general equation, which is the subject of this article, is based on inelastic deformations, and has been developed as a result of recent discussions of the Commission on Hyperstatism* in connection with the European Committee for Concrete. Some other proposals put forward to date include an approximate theory⁽¹⁾ and a moment-distribution method⁽²⁾, both by Y. Guyon, a precise method for continuous beams⁽³⁾ by G. Macchi, and a limit method⁽⁴⁾ by the writer. The general equation may be applied readily to simple frames and continuous beams, but a special application of a modified limit method⁽⁴⁾ is probably a more suitable ultimate-load method for more complex frames. The general equation might be extended to three-dimensional frames.⁽⁵⁾

Notation.

Reference should be made to Figs. 1, 2, 3 and 4 on pages 96 and 98.

 $X_i, X_k = \text{Unknown moments (assumed = 1) acting at hinges i and k respectively.}$

 $\overline{X}_i, \overline{X}_k = \text{Known plastic moments (assumed} = 1)$ acting at hinges i and k respectively.

M =Bending moment generally.

 M_i , $M_k = \text{Ordinates of diagram of distribution of moments due to } X_i = 1$ and $X_k = 1$ respectively.

 M_0 = Ordinate of diagram of moments due to external load.

 $\phi_0,\,\phi_i,\,\phi_k=rac{e_{ee}}{n_e d}$ or rotation per unit length due to moment $M_0,\,M_i$ and M_k respectively.

 $\overline{\phi}$, $\overline{\phi}' = \frac{\delta_d}{\overline{n}_d}$ or inelastic rotations per unit length when $\frac{M}{EI}$ and $\frac{M}{E'I'}$ respectively are assumed to be elastic. (See Fig. 3c and b.)

$$\theta_i = \int_0^{\overline{L_p}} \overline{\phi} . ds = \overline{\phi} \text{ max. } L_p. \text{ (See Fig. 3c at hinge i.)}$$

$$\theta_{i'} = \int_0^{\overline{L_p}} \overline{\phi'} . ds. \text{ (See Fig. 3b at assumed hinge section i.)}$$

(1). Y. GUYON.—"The Strength of Statically Indeterminate Prestressed Concrete Structures." Symposium on the Strength of Concrete Structures. London. 1956.

(2). Y. GUYON.—"Cadres—Commentaires et Propositions." Note for Commission on Hyperstatism. (Comité Européen du Béton.) 1960.

(3). G. Macchi.—" Moment Redistribution beyond Elastic Limit and at Failure in Prestressed Concrete Beams." Symposium on Plasticity in Strength of Materials and Structural Design. Varenna. 1956.

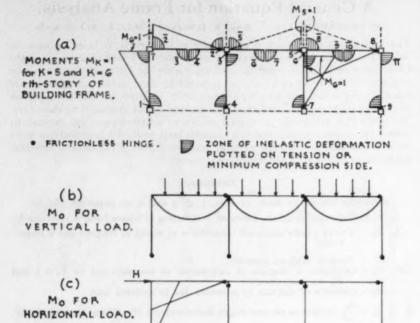
"Comments on various Proposals." Note for discussion by Commission on Hyperstatism. (Comité Européen du Béton.) Stockholm. 1960.

Bulletin No. 21. (Comité Européen du Béton.)

(4). A. L. L. BAKER.—"The Ultimate-Load Theory applied to the Design of Reinforced and Prestressed Concrete Frames." Concrete Publications Ltd. London. 1956.

(5). A. L. L. Baker.—" A General Analysis of Elasto-plastic Three-dimensional Frames." Publications of International Association of Bridge and Structural Engineering. Zürich.

* Some comments on the work of the Commission are given in this number; see " Editorial Notes", page 93.



(d) RESULTANT BENDING MOMENTS.

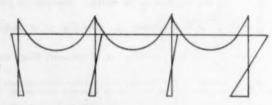


Fig. 4.

 $\psi = As \theta'$ but at critical section between assumed hinge sections.

 $E = \frac{c}{c_0}$ for values at L₁; $E' = \frac{c}{c_{co}}$ for small values of c and c_{cc} .

I, $I' = \frac{Mn_cd}{c}$ for values at L₁; and for small values of c and M respectively.

 $L_p = \text{Equivalent inelastic length} = \frac{\theta}{\frac{1}{2} \text{max}}$. See Fig. 3c.

 $\overline{L}_p =$ Actual inelastic length. See Fig. 3b. e_{ee} , $e_{eu} =$ Strain of concrete at L_1 (or smaller values) and at L_2 respectively. e_{gg} , $e_{gu} =$ Strain of steel at L_1 and ultimate strain of steel respectively.

 $e_e = e_{eu} - e_{ee}$

- c_i , c_i , c_i = Concrete stress generally and at L_1 and L_2 respectively. t_i , t_i = Steel stress at L_1 and ultimate steel stress respectively.
 - d =Effective depth of section.
- $n_e d$, $n_u d$ = Neutral-axis depth at L₁ and L₂ respectively.
 - nd = Neutral axis depth for change of strain from L, to L,
- $L_1 = A$ limit point on the moment-curvature diagram of the critical section of a member (see Fig. 1) where either the steel or the concrete develops yield stress. Yield stress in the concrete is assumed to be the cylinder strength and to occur at a strain of 0.002, and in the steel when an offset strain of 0.001 develops.
- $L_2=$ a limit point on the moment-curvature diagram, where either the concrete or steel develops ultimate stress. The ultimate stress of concrete is assumed to be cylinder strength and the ultimate strain to be 0.0035 in unbound concrete or 0.01 in well-bound concrete. For steel, the ultimate stress is assumed to be a mean between the yield and ultimate stresses.
- At limits L_1 and L_3 , the distribution of strain in the concrete across a section is assumed to be linear, and distribution of compressive stress in the concrete to be parabolic.

General Compatibility Equation-Ultimate Condition.

In a frame which is *n*-times statically indeterminate, insert *n*-frictionless hinges so that the frame becomes statically determinate and remains stable. Assume external equal and opposite bending moments X_i , X_k , etc., to act at hinge sections i, k, etc., on the members on either side of the hinge sections. Plot moment-diagrams for $X_i = \mathbf{1}$, $X_k = \mathbf{1}$ on the tension, or minimum-compression side of the members. Also, indicate at all critical sections $\mathbf{1}$ to n and $\mathbf{1}$ to n the zones of inelastic deformation (Fig. 4a) on the tension or minimum compression side of the member. At this stage, the sign of the resultant bending moment at the critical sections must be assumed. Checking and adjustment, if necessary, is made later.

When, at any section i, all external loads and moments $X_1 \ldots X_n$ act, continuity at the section is retained by including inelastic deformation as distributed. As an external moment, therefore, X_i does not rotate, and the virtual work done by $X_i = 0$. The virtual work done by X_i (assumed = 1) is zero, and by the internal equilibrating restraint moments M_i is zero. The total virtual work done by M_i is due to the following.

- 1.—Rotations ϕ_0 caused by external load. 2.—Rotations ϕ_4 caused by M_4 or $X_4 = 1$.
- 3.—All rotations (such as ϕ_k) caused by all moments (such as $X_k = \mathbf{I}$) which act on the same members as $X_k = \mathbf{I}$.
- 4.—All inelastic rotations (such as ϕ') which occur in members acted on by X_t .

 The sum of the above items of virtual work is zero, which establishes the following general compatibility equation, which is twicel for any bines section.

The sum of the above items of virtual work is zero, which establishes the following general compatibility equation, which is typical for any hinge section such as i.

$$\int M_i \phi_0 . ds + X_i \int M_i \phi_i . ds + \Sigma X_k \int M_i \phi_k . ds + \Sigma \int M_i \vec{\phi}' . ds = 0 \quad . \quad (1)$$

By definition $\phi = \frac{e_{cs}}{n_s d} = \frac{c}{E'n_s d} = \frac{M}{E'I'}$ for small values of e_{cs} , that is E'I' is based on the line OA (Fig. 2).

Referring to Fig. 3, at any inelastic zone

$$\int M_i \phi' . ds = M_i' \int \phi' . ds = M_i' \psi = M_i \psi$$

very approximately, since the influence of inelastic rotation is governed by the large deformations which occur close to the critical section. Equation (1) can therefore be written

$$\int \frac{M_i M_0}{E'I'} ds + X_i \int \frac{M_i M_i}{E'I'} ds + \Sigma X_k \int \frac{M_i M_k}{E'I'} ds + M_i \phi_i' + \Sigma M_i \psi_n = 0$$
 (2)

For i = 6 (refer to Fig. 1), equation (2) becomes

$$\int \frac{M_{6}M_{6}}{E'I'}ds + X_{6} \int \frac{M_{6}M_{6}}{E'I'}ds + \Sigma X_{k} \int \frac{M_{6}M_{k}}{E'I'}ds + 1.\theta_{6}' + 1.\psi_{1} + 1.\psi_{2} \\
- \frac{1}{2}.\psi_{2} - \frac{1}{2}.\psi_{4} - 1.\psi_{5} + \frac{1}{2}.\psi_{5} + \frac{1}{2}\psi_{10} = 0. \quad (3)$$

The signs are positive when M_i and M_k or M_i and inelastic diagrams are on the same side of a member, and negative when on opposite sides.

To obtain the ultimate strength of a frame or the moment distribution at any stage of loading, the procedure is as follows.

I.—The $\frac{M}{\psi}$ curve (refer to Fig. 2) must be known for each critical section.

2.—The \dot{X} -values must be adjusted until all the ψ -values and their signs are compatible with the resultant moments at each critical section 1 to n and $\bar{1}$ to \bar{n} .

This procedure may be practical in the case of simple indeterminate structures, such as continuous beams, when the $\frac{M}{\psi}$ curves are known. In general, however, compatibility is very easily obtained by making certain simplifying assumptions justified by the use of safe limiting values.

Simplified Limit Design.

Assume the $\frac{M}{\phi}$ curve (Fig. 2) and $\frac{M}{\psi}$ curve (Fig. 2) is linear from 0 to L₁, and that M is constant between L₁ and L₂, except for a small increase of deformation beyond L₁. Then in equation (1), for values at L₁ $\phi = \frac{e_{e\theta}}{n_e d} = \frac{c}{E n_e d}$. By definition, $I = \frac{M n_e d}{n_e d}$ for values at L₁; therefore

$$\int M_i \phi_k . ds = \int \frac{M_i M_k}{EI} ds.$$

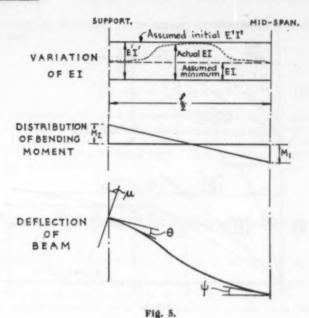
If all members between sections $\bar{\imath}$ to n are designed so that limit L_1 is not exceeded (that is at all sections $\bar{\imath}$ to \bar{n}), then in equation (1) all ψ -terms become zero and X-terms become \bar{X} , giving the following typical general equation of compatibility.

$$\int \frac{M_i M_0}{EI} ds + \mathcal{R}_i \int \frac{M_i M_k}{EI} ds + \Sigma \mathcal{R}_k \int \frac{M_i M_k}{EI} = -\theta_i \quad . \tag{4}$$

Compatibility of the resultant moment and θ -values is then easily obtained by I.—Calculating M_{θ} -values from the external load.

2.—Assuming X-values so that all θ -values are of the correct sign, that is positive when the corresponding X-value is positive, and so that all θ -values lie between L_1 and L_2 (Fig. 4) for the particular critical section.

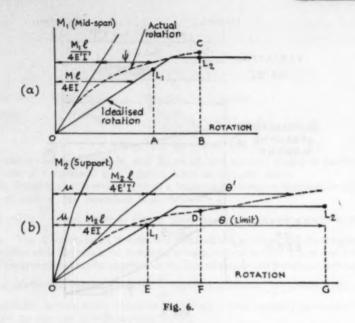
3.—Designing sections I to \$\vec{n}\$ so that stresses L1 are not exceeded.



To satisfy conditions I to 3, the positions of hinges I to n are chosen at the probable sections of maximum stress for elastic conditions throughout. X-values assumed equal to X-values for elastic conditions would then give all θ -values equal to zero. X-values may be assumed between o and elastic X-values, so that the θ -values are not excessive. If hinge sections are designed to have ultimate moments of resistance, that is X-values slightly less than the elastic X-values, then θ -values will be positive and probably lie between L₁ and L₂ sections $\overline{1}$ to \overline{n} being designed so that stresses do not exceed values at L, that is the frame is designed not to yield between plastic hinges and hinge positions are selected, and the sections at hinges are designed, so that θ -values have the correct sign and are not excessive in value. The process of obtaining compatibility, therefore, merely entails adding the terms of the left-hand side of the equations, and occasionally by design, adjusting X-values or permissible values of θ at the hinges, so that actual values of θ are not excessive. In each compatibility equation there is only one unknown, namely θ , and the procedure for designing a frame many times statically interdeterminate can therefore be simple.

Calculation of Permissible Values of θ .

Compatibility of the resultant bending moments at plastic-hinge sections with θ -values is satisfied if θ does not exceed a maximum permissible value equal to the increase of rotation which occurs between L_1 and L_2 . The following



semi-empirical formulæ for permissible values of θ are proposed (pending the results of further tests).

$$\theta = \frac{(e_{\rm cw}-e_{\rm ce})}{n_{\rm u}}\,\frac{k_1k_3}{k_2} \mbox{ (tension occurs; values at critical section)}.$$

$$\theta=(e_{cu}-e_{co})rac{k_1k_3}{k_2}$$
 (no tension occurs; values at critical section). $L_g=rac{k_1k_3}{k_2}d$.

$$k_1 = 1$$
 for mild steel, $k_1 = 1.3$ for cold-worked steel.

$$k_1=1$$
 for mild steel, $k_1=1\cdot 3$ for cold-worked steel. k_2 has a linear variation between the following limits (see Fig. 3).— $k_2=0\cdot 6$ when $e_g=3\times 10^{-5}$ and $k_2=2\cdot 5$ when $e_g=10\times 10^{-5}$; $e_g=\frac{0\cdot 002-e_1}{Z}$, where

 e_1 is the ultimate strain due to axial load at the section of no bending moment and Z is the distance (in inches) from the critical section to the section of no bending moment. If Z is measured in centimetre, the limiting value of e_a must be multi-

plied by 0.4. For bending only, $e_1 = 0$; $e_1 = 0.002 \sqrt{\frac{c_1}{0.85c_u}}$, where c_1 is the concrete stress at the point of contraflexure due to an axial force.

 $k_3 = 1.5$ for concrete having a cube-strength of 2000 lb. per square inch; $k_3 = 1$ o for 6000 lb. per square inch.

Degree of Error in Limit Design.

Consider a typical beam in a building frame (Fig. 5). By limit calculations, 102 March, 1961.

a hinge occurs at the support. The support joint rotates μ , and the mid-span slope is zero.

Then

$$\mu + \theta' + \frac{M_2 l}{2E'I'} - \frac{(M_1 + M_2)}{4E'I'}l - \psi = 0.$$
 (5)

For compatibility of moment-values and rotations, for any particular load, corresponding points in the broken-line diagrams in Fig. 6a and b must be vertically in line. If the beam deforms in accordance with the idealized assumptions, $\psi = 0$, E'I' is replaced by EI and θ' by θ . Then, for compatibility of moment-values and deformation,

$$\frac{M_1 l}{4EI} = \frac{M_2 l}{4EI} + \mu + \theta. . . . (7)$$

By definition $\frac{M_1l}{4EI} > \frac{M_1l}{4E'I'} + \psi$; therefore L₁ is to the right of the broken-line curve in Fig. 6a.

Similarly $\frac{M_{gl}}{4EI} > \frac{M_{gl}}{4E'I'} + \theta'$; therefore L_1 is to the right of the broken-line curve in Fig. 6b. By definition, L_2 is always below the dotted curve and to the left of the point of ultimate rotation, or very approximately so.

The case for minimum "actual" ultimate bending strength as compared with "calculated" strength by limit assumptions, occurs when the mid-span critical section designed by limit calculations not to become a plastic hinge, is brittle and the value of μ is such as to cause L_1 (mid-span) to be only just to the right of L_1 (support), that is, so that the rotation of the support hinge by limit calculation is small.

By limit calculation, $M_1 + M_2 = AL_1 + GL_2$. Actual ultimate value of $M_1 + M_2 = BC + DF$.

It is seen that only in a most extreme case can $AL_1 + GL_2$ exceed BC + DF and never be greater than $AL_1 + EL_1$. If excessively brittle sections are avoided, even when the value of μ is the worst possible, $AL_1 + GL_2$ cannot exceed BC + DF.

A similar proposition can be established for a case in which, by limit calculations, a plastic hinge is found to occur at mid-span instead of at the support.

General Comments.

For a rigorous investigation, each possible critical distribution of live-load with corresponding hinges requires investigation. When the live-load is not great in relation to the dead-load, the total distributed load may be assumed to be critical, since then rotations are greatest.

Generally it is sufficient to determine approximately the distribution of bending moments for θ -values = 0. In the case of continuous-beam bridges, it may be important to calculate precisely the influence of inelastic rotations at working load on the distribution of the bending moments.

FIFTY YEARS AGO.

From "Concrete and Constructional Engineering", March, 1911.

A Chimney Constructed with Precast Units.





"The special block used in this method of chimney construction (the Monoshaft method adopted by Messrs. L. G. Mouchel & Partners) has a claw-shaped socket at one end. Each block is to in. deep, and of a width and length which can be varied for each shaft, care being taken in the designing to make them of such size that they shall not be unwieldy. The internal part of the claw allows of the passage of the vertical reinforcement, thus securing a good bond; this socket is also of a sufficient width to allow the plain end of the next block to be inserted for a variable distance, thereby making it possible to reduce the diameter of successive courses, and effecting any desired taper to the shaft. In addition to this, the outside of the claws, coming at every external angle, forms an effective vertical rib, and gives a very good appearance to the shaft quite absent from brick chimneys. The space left in the sockets is filled up with a semi-dry concrete similar to the concrete of which the blocks are built, and this leaves the whole one solid mass."



Fig. 1.

The Substructure of the Forth Road Bridge.

THE new road bridge, being constructed for the Forth Road Bridge Joint Board over the Firth of Forth, Scotland, about 1-mile upstream from the famous railway bridge, will be a suspension bridge having a main span of 3300 ft. and two side spans of 1340 ft. each. A clearance of 150 ft. above high water will be provided. The bridge will be the longest suspension bridge in the world outside the U.S.A. A model of the bridge is shown in Fig. 1. The deck will be suspended by wire-rope hangers of about 11-in. diameter from two main cables which will be about 24 in. in diameter and each will be composed of twelve-thousand o-196-in. high-tensile steel wires. The cables will pass over two main steel towers more than 500 ft. high and two reinforced concrete side towers (Fig. 2) which extend up to the deck. The deck of the main span will be of steel. A reinforced concrete slab on steel girders will be provided for the side spans. . There will be two 24-ft. carriageways, two 9-ft. cycle tracks, and two 6-ft. footpaths. The approach viaducts comprise seventeen spans of which the longest will be 170 ft. There will be twelve miles of approach roads.

Anchorage of the Main Cables.

The ends of the main suspension



Fig. 2.-Construction of the Side Towers on the Northern Shore.

March, 1961.



Fig. 3.-Cables Protruding from Lower End of Anchorage.



Fig. 4.—Upper End of Anchorage showing Anchors for Prestressing Cables.



Fig. 5.—Granite Aggregate Stuck to the Inner Face of the Shuttering.

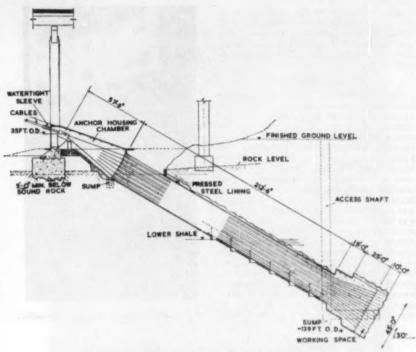


Fig. 6.-Details of Anchor-block on Southern Shore.

cables are secured to four prestressed concrete anchor-blocks cast in tunnels in the rock of the shores of the Firth. The blocks in the southern shore (Fig. 6) are about 260 ft. long, from 25 ft. to 45 ft. in diameter and at an angle of 30 deg. with the horizontal. In the northern shore the blocks are shorter, the rock being stronger. Each anchor-block is prestressed with 456 wire strands each of 11-in. diameter. The strands are enclosed in metal sheaths. four strands extending from end to end of the anchor-block in each sheath. The upper ends of the four strands in each group are embedded in a white-metal cone which, when the strands are tensioned, is drawn into a steel cylinder bearing on a thrust-plate at the face of the anchorblock (Fig. 4). In front of the thrustplates and tied back to them are steel saddles around which pass the thirtyseven strands of each main suspension cable. Thus the tension in the suspension cable is transferred through the prestressing cables to the lower end of the anchorblock (Fig. 3). The strands in each prestressing cable were tensioned at the same time by four hydraulic jacks at the lower end of the anchor-block, and were anchored at that end separately in wedge anchors bearing on steel plates at the face of the concrete.

Each anchor-block was constructed as follows. The tunnel was excavated and the roof supported by pressed-steel lining. The cable sheaths were then placed in position and supported by templates (Fig. 7) and the tunnel was filled with concrete except for a working space at the lower end (Fig. 6) where the prestressing cables were to be tensioned. When the concrete had hardened the space between the roof of the tunnel and the steel lining was filled with grout under pressure. The cables were then passed into the sheaths and tensioned. Access to the lower ends of the anchor-blocks was by a vertical shaft and horizontal galleries in each

bank. The shaft on the southern bank was about 160 ft. deep. When the prestressing cables had been tensioned the working spaces were filled with concrete and the access shafts and tunnels with rock.

Side Towers.

The side towers are hollow rectangular columns of prestressed concrete. prestressing cables are made up of wire arranged in parallel and are fixed into the rock at the lower ends and tensioned from the top. Each of the eighty cables applies a prestressing force of 120 tons. Climbing cranes inside the hollow columns (Fig. 8) were used to raise the materials for the construction of the columns. One lift of shuttering (Fig. 8) about 6 ft. 9 in. high was provided for each concrete tower and was raised by means of hydraulic jacks operating from a steel structure inside the hollow tower. The shuttering was composed of steel frames with wooden facing and was supported on the hardened concrete of the tower while new concrete was placed. For a few feet above ground all concrete is faced with exposed granite aggregate. The pieces of stone (Fig. 5) were stuck to the surface of the shuttering

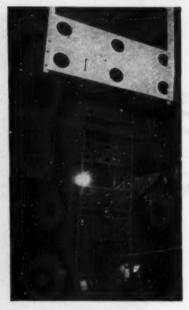


Fig. 7.—Templates for Cable Sheaths.

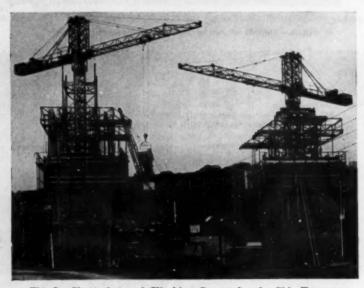


Fig. 8.—Shuttering and Climbing Cranes for the Side Towers.



Fig. 9.-Construction of the Main Tower Foundations in Cofferdams.

with a water-soluble adhesive immediately before placing the concrete. All other concrete surfaces were treated with a white cement finish.

Foundations.

The foundation of the southern main tower was constructed in double circular open cofferdams (Fig. 9). Two steel and concrete cylinders were sunk through boulder clay to rock which was 100 ft. below water. The concrete foundation pier was cast on the cylinders. The steel bases of the main towers are embedded in the foundation piers, to which the vertical thrust is transferred by a number

of steel lugs projecting from, and welded to the side of, the base and transmitting the load to the foundation over a depth of several feet.

Concrete for the southern anchorblocks was prepared in the plant shown in Fig. 10. The mixer is a 1-cu. yd. high-speed machine driven by a 35-h.p. electric motor. Concrete was pumped from the mixer to the anchor-blocks by means of air compressed in the cylinder on the right of the illustration. The cement for the works on the southern side is being brought in special railway trains of 20-ton pressurised-wagons from which the cement is discharged pneumatically at the rate of

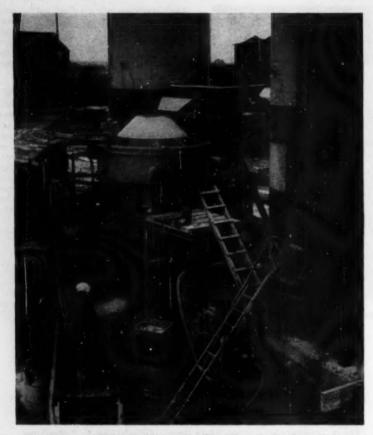


Fig. 10.-Concrete Mixing and Pumping Plant for the Southern Anchorages.

a ton per minute by a pump operated by a diesel motor. The cement is fed into pressurised-tank road vehicles in which it is transported to the site. Up to 500 tons of cement is delivered by the train to South Leith where there is a 200-ton silo

which is filled directly from the railwagons and from which extra supplies are taken when required on the site.

The consulting engineers are Messrs. Mott, Hay & Anderson. The contractors are Messrs. John Howard & Co., Ltd.

Publications Received.

- "Hydraulics Research 1959." Report of the Hydraulics Board of the Department of Scientific and Industrial Research.
 (London: H.M.S.O. 1960, Price 5s. 6d.)

 "Basic Road Statistics." (London: Brit-
- ish Road Federation. 1960. Price 1s.)
- "A Guide to Engineers on the Making Up of Private Streets." Department of Scientific and Industrial Research. Road Note No. 26. (London: H.M.S.O. 1960. Price 1s.)

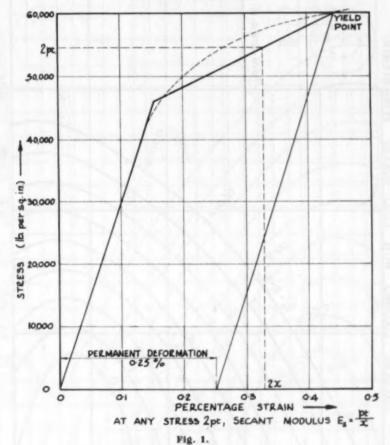
The Design of Eccentrically-loaded Circular Columns by the Load-factor Method.—II.*

By J. D. BENNETT, B.Eng.

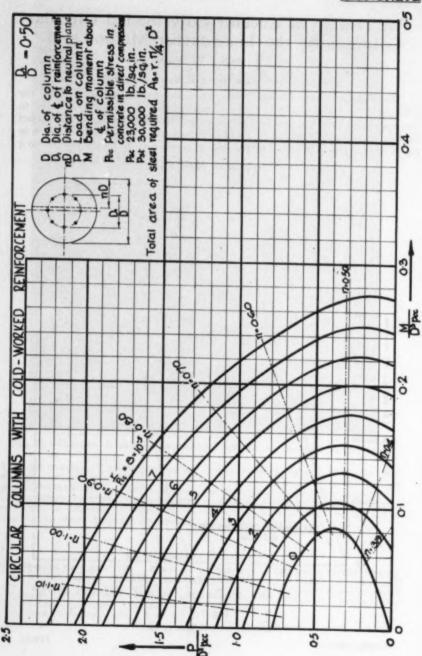
Columns with Cold-worked Reinforcement.

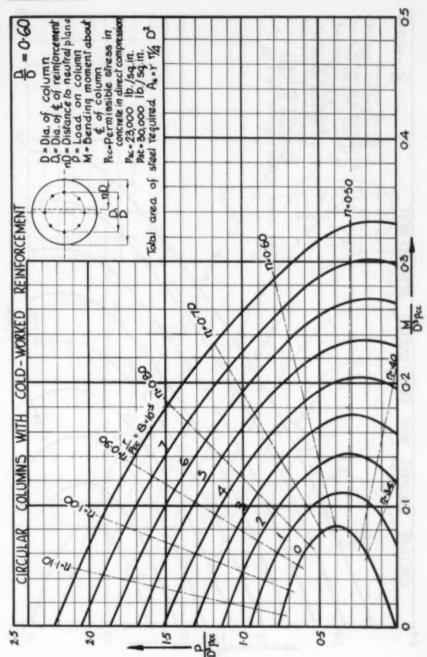
The difference between mild steel and cold-worked steel, apart from the different permissible stresses, is that cold-worked steel is not fully elastic up to the guaranteed yield stress. To determine the secant modulus $E_{\mathfrak{g}}$ of cold-worked steel at any particular stress, the simplified stress-strain relationship is shown in Fig. I, from which it is seen that the steel is assumed to be fully elastic up to a

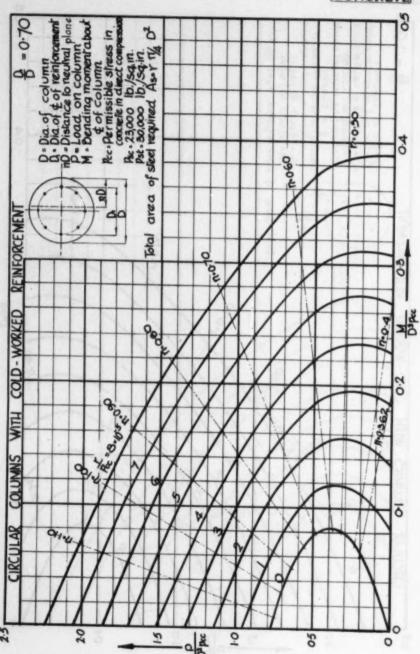
(Continued on page 117)

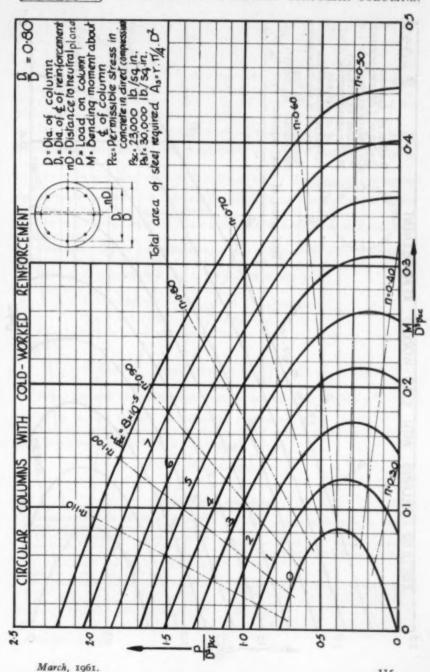


* Continued from February, 1961.

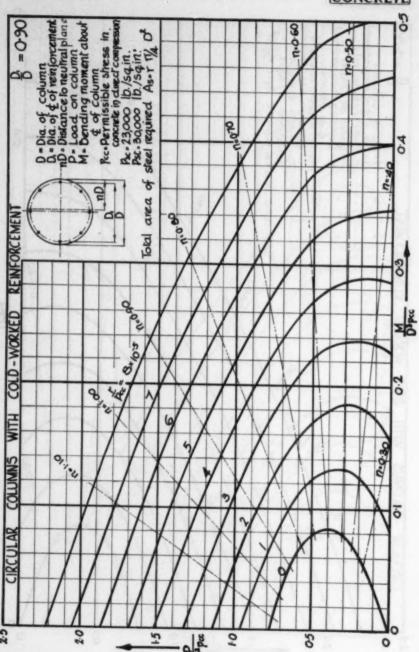








115



stress of 46,000 lb. per square inch with a modulus of elasticity of 30×10^6 lb. per square inch. At stresses greater than 46,000 lb. per square inch a straight-line relationship is assumed between stress and strain as far as the yield stress of 60,000 lb. per square inch, which occurs when the permanent deformation is $\frac{1}{2}$ per cent. and the elastic deformation calculated on a modulus of 30×10^6 lb. per square inch is 0.2 per cent. These assumptions are safe for a steel complying with the minimum requirements of the Code and enable the secant modulus of the steel to be readily calculated for any stress.

The notation and other assumptions are as given in Part I and, as for columns with mild steel reinforcement, five design charts are given for values of $\frac{D_1}{D}$ ranging

from 0.5 to 0.9 and values of $\frac{r}{p_{ce}}$ from 0 to 8 × 10⁻³. The values of n shown on the charts can be used when checking the design, if the reinforcement is widely or unevenly distributed in the column.

The procedure for using the charts is the same as for columns with mild steel reinforcement.

Example.—Design a circular column with a diameter of 2 ft. to support a direct load of 300,000 lb. and a bending moment of 1,500,000 lb.-in.

Using a 1:2:4 concrete: $p_{ce} = 760$ lb. per square inch.

Therefore

$$\frac{P}{D^2 p_{ee}} = \frac{300,000}{24^2 \times 760} = 0.685, \ \frac{M}{D^8 p_{ee}} = \frac{1,500,000}{24^8 \times 760} = 0.143.$$

Providing $1\frac{1}{2}$ in. cover of concrete to $\frac{1}{4}$ -in. links, $D_1=24-3-0.5-1=19.5$ in.

$$\frac{D_1}{D} = \frac{19.5}{24} = 0.81.$$
 From the chart for $\frac{D_1}{D} = 0.80$, $\frac{r}{p_{cc}} = 2.25$.

Hence the area of reinforcement required is $2.25 \times 10^{-5} \times 760 \times \frac{\pi}{4} \times 24^{\circ}$ = 7.74 sq. in., say thirteen $\frac{7}{4}$ -in. diameter cold-worked bars.

The basis of the charts for mild steel and cold-worked reinforcement will be given in subsequent numbers of this journal.

(To be concluded).

Publications Received.

- "Background of the Swedish Tentative Standard Specifications for Limitation of Crack Widths in Reinforced Concrete Structures." By P. O. Jonsson, J. Osterman and G. Wastlund. (Stockholm: Swedish Cement and Concrete Research Institute. 1960. Price Kr. 2.)
- * "Slip Between Reinforcement and Concrete." By S. T. A. Ödman. (Stockholm: Swedish Cement and Concrete Research Institute. 1960. Price Kr. 2.)
- These papers are reprints in English of contributions to the RILEM Symposium on Bond and Crack Formation in Reinforced Concrete held in Stockholm in 1957.
- "National Civil Engineering Laboratory of Portugal." (Lisbon: Ministry of Public Works. 1960. In Portuguese and English.)

Book Reviews.

"The Technology and Properties of Heavy Concrete." Edited by A. E. Desov. [Moscow: Gosstroiizdat (State Publishing Office for Literature on Building, Architecture and Building Materials). 1959. 10v. 50h. (about 955.)]

This book, in the Russian language, contains eight papers dealing with research on three aspects of heavy concrete, namely, compaction by vibration, shielding from radioactive sources, and autoclaving. The subjects of the papers are: Efficient methods of vibrating concrete. Methods of casting silicate mixtures by vibration. Criteria for uniform intensities of vibrations with different frequencies. Properties of heavy concrete designed for shielding from radioactive sources. The design of special concretes of given density, strength and workability. Some questions on the technology and properties of autoclaved concrete. Factors affecting the strength of autoclaved concrete. Research on the modulus of elasticity of autoclaved concrete. The papers have been compiled after studying relevant American and European literature. Some of the conclusions are as follows:

Tables vibrating in two directions are recommended for casting large pieces. Limonite concrete has good resistance to frost. Reinforcement does not corrode in concrete made without the addition of calcium chloride when irradiated with gamma-rays, but in the presence of calcium chloride corrosion is more intense than when the specimens are not irradiated. Bonding of reinforcement in concrete cured in an autoclave is generally no different from bonding in concrete cured by normal methods.

Steam-treatment of concrete made with high-alumina cement at 174 deg. C. gives strengths at one day three times that normally obtained. Autoclaved concrete with compressive strength of over 7000 lb. per square inch can be obtained from a mixture comprising 24 per cent. of high-strength Portland cement, 16 per cent. of ground sand and 60 per cent. of unground sand, using a water-cement ratio of 0.45. The modulus of elasticity of autoclaved concrete is significantly lower than of normally-cured concrete one to three days after steaming. Increasing the tempera-

118

ture of autoclaving lowers the modulus of elasticity by altering the composition of the hydration products and size of crystal by increasing the flaws and by drying the concrete more fully.

"Bauen mit Stahlbetonfertigteilen."
(Building with Prefabricated Reinforced Concrete Units.) By László Mokk. [Budapest: Akadémiai Kiadó (Publishing House of the Hungarian Academy of Sciences.) 1960. 7.00 dollars.]

This book is a German translation of the second edition of a Hungarian book which has already been translated into several languages in Eastern Europe. It is a comprehensive text book on the use of precast concrete members in industrial buildings. The trend towards prefabrication in concrete is general in most countries but is probably more widespread in countries behind the Iron Curtain than in the western hemisphere. It was particularly so in Hungary where the shortage of timber and steel after World War II compelled engineers to concentrate their effort on eliminating scaffolding and reducing the amount of shuttering.

The book is an impressive record of the achievement of Hungarian engineers since 1947. It is divided into six sections, the first of which contains a short history of prefabrication in concrete and establishes the basic principles of this method as regards work in factories and at sites, The essential condition for prefabrication is repetition which must be taken into account at the design stage. the connection of the precast members is one of the main difficulties, it is advantageous to have the least number of joints. The greatest size of a member is governed by the equipment available for transportation and erection. Owing to the high cost of transporting heavy loads in Hungary, large members are generally precast at the site.

The second section deals with the subdivision of various types of structures into convenient units and with their joints. Many interesting and ingenious solutions are described in great detail and illustrated.

The third section is devoted to problems of manufacture, site organisation, moulds, lifting and erection. It is re-



commended that moving heavy members horizontally should be avoided. Such members should be cast in a position which allows them to be erected by tilting and lifting only. The greatest weight for which lifting equipment is now available in Hungary is 60 tons.

In the fourth section various types of cranes and masts and the methods of using them are described. The need for taking safety precautions for the work-

men is emphasised.

The fifth section contains about seventy typical examples of completed structures, mainly in Hungary, but also in other countries including England. In many cases the greatest weights of members and the quantities of concrete and steel (per square metre of area covered) are given. Most impressive is an Hungarian power station with columns up to 108 ft.

long and beams up to 137 ft. long, both members weighing 60 tons each. The beams had to be lifted to a height of over 100 ft. In another power station ell-shaped wall units 108 ft. high and 13 ft. wide, with exposed-aggregate surfaces, were used resulting in a novel architectural appearance. There are also many examples of prefabricated shell structures of various shapes.

In the last section the economic aspects of prefabrication are summarised. These vary from country to country, depending on the relative costs of labour and materials, and, where timber is scarce, on the availability of foreign currency.

The book is very well illustrated with diagrams and photographs many of which are self-explanatory so that it should be of great interest even to readers without a knowledge of German.—K. H.-K.

Tests on Joints in Precast Members.

Dr. K. Hajnal-Kónyi writes as follows. "Some of the results given in the article entitled 'Tests on Joints subjected to Bending and Shearing in Precast Members' by W. J. Larnach, which was published in this journal for December 1960,

are rather puzzling.

For instance, the 'plain beams' corresponding to joints Nos. 1, 4, 5 and 6 were each reinforced with two plain 1-in. mild steel bars. Although according to B.S. Code No. 114 these beams were 'overreinforced' they were, in fact, underreinforced and failure should have occurred by yielding of the steel. The variation of the cube-strength was comparatively small. With an assumed cylinder-strength of 4000 lb. per square inch and an assumed yield-point stress of the steel of 36,000 lb. per square inch, I calculate that the ultimate moment of resistance is approximately 60 in.-ton, which agrees with the results of beams Nos. 4 and 5, since the yield-point stress was probably higher than assumed by me. How, however, can the resistances of the first and last beams (43.5 and 75.0 in.-ton respectively with practically the same cube-strengths) be reconciled with each other and with the theoretical value?

Also, according to Fig. 6c, there was no deflection of the 'plain beam 'for Joint No. 3 due to a moment of about 10 in.-ton.

If this were true it would be an exception to the accepted rules of the theory of elasticity."

MR. W. J. LARNACH replies as follows.

"With the reported yield-point stress of 18-0 tons per square inch, the estimated failing moment for the plain beams Nos. 1, 4, 5 and 6 is about 65 in.-ton, and the actual results for Nos. 4, 5 and 6 are in tolerable agreement with this value. In Joint No. 1, which was the first to be tested, nominal web reinforcement only was provided, and the plain beam failed by shearing at the applied moment stated. The efficiency as reported is correct for the test as conducted, but expressed on the basis of the estimated failing moment it is about 23 per cent.

I am indebted to Dr. Hajnal-Kónyi for drawing attention to the small error in Fig. 6c. The corrected curve would be slightly above the curve shown."

British Standard for Sound Insulation and Noise Reduction.

The price of British Standard Code of Practice CP 3 (Chapter III, 1960), "Sound Insulation and Noise Reduction", which is mentioned in this journal for December 1960, is 20s.

Lift-slab Method of Construction.

THE lift-slab method of construction is now being used for several buildings in Great Britain. Since the method originated in America, the principal features of the system are described in connection with a multiple-storey hospital building in the U.S.A., which precedes descriptions of some buildings in this country.

I.—SIX-STOREY BUILDING IN U.S.A.

The four upper floors, the main roof and the roof of a penthouse of a six-storey building at Litchfield County Hospital, Winsted, Connecticut, were erected by the lift-slab method. The building is believed to be the tallest prestressed structure erected by this method.

The floors and the main roof are 46 ft. wide by 183 ft. long, and are of the "flatplate" type of construction, that is without projecting beams. The roof of the solarium is 41 ft. wide by 80 ft. long, and was lifted 62 ft. The six slabs were cast, one on top of the other, on the basement. Four slabs overhang 3 ft. beyond the walls on one side. The side walls are supported by the slabs and are of glass and thin metal panels. The end walls are of masonry.

The structure is supported by fourteen columns, with flanges 14 in. wide, spaced 26 ft. apart in both directions, and each slab is cantilevered on all four sides. The slabs weigh 400 tons each. The collars on the columns are recessed into the slabs to allow metal-lath and plaster to be applied to the ceiling. The prestressed slabs for the three upper floors and the main roof are similar. The lowest floor slab has no canopy along one side. The roof of the

solarium is about half the size of the floors and is supported on six columns.

Design of Slabs.

The arrangement of the slabs is shown in Fig. 1. The transverse distance between the columns results in the maximum negative and positive bending moments being nearly equal. Two stairwells (8 ft. by 11 ft.) and an elevator shaft (9 ft. by 17 ft.) occur in regions of critical stress. The slabs are prestressed in both directions. The structural analysis was carried out by the moment-distribution method for the width of a bay of 26 ft. and two columns in the transverse direction, and in the longitudinal direction for a width of slab equal to half that of the building with seven columns for support. Stiffness of the slab was essential. The modulus of elasticity of the concrete was assumed to be 800 x cylinder-strength to allow for plastic flow. Moments due to dead load were calculated on the assumption that the slabs were simply supported, since the columns could exert no restraint during lifting. Moments due to live loads were calculated on the assumption that full rotational restraint was exerted by the connections of the slab to the columns.

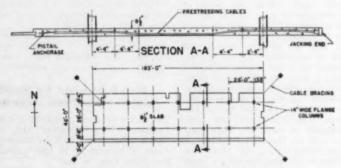


Fig. 1.-Plan and Cross Section of Typical Floor.

This restraint was obtained by welding the bottoms of the lifting-collars to the columns and welding steel wedges between the columns and the tops of the collars.

Because of the large (30 in. square) lifting collars, the maximum negative moment at the centre-lines of the columns was reduced by 15 per cent. at the critical section. The shearing force at the perimeter of the column was not important since the principal tensile stress was only 60 lb. per square inch at a typical interior column where compressive stresses due to prestressing were lowest.

Calculations indicated that the longer sides of the slabs would deflect upward by about # in. during lifting, due almost entirely to the weight of the slab. Forces

the underside of the basement floor slab. (2) When the filling had been compacted. the columns were erected and plumbed. The collars were then fitted to the columns and temporarily fixed to them a few feet above the basement slab. (3) After the services and the mesh reinforcement were placed, the slab was cast and depressions were formed for quarry-tile and other finishes; these depressions were filled with dry sand to within 1 in. of the surface and a skim coat of mortar placed over the sand to provide a level base on which to cast the next slab. (4) The concrete was finished with a steel trowel and kept moist for about 18 hours. The material used to prevent the upper slab from sticking also acted as a curing medium for the basement slab. (5) Wire mesh reinforcement was

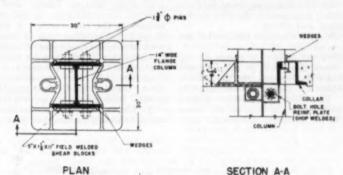


Fig. 2.-Details of Lifting Collar.

due to prestressing caused only about 7 per cent. of the deflection. An additional upward deflection of \$\frac{1}{4}\$ in. was expected after the application of the live loads. The actual deflections in the transverse direction during lifting were found to be considerably smaller than those calculated, and slightly in the reverse direction—about \$\frac{1}{4}\$ in. downward at the edges and about \$\frac{1}{4}\$ in. upward at the centre of the 26-ft. span. The extra stiffness may have been due to the strength of the concrete being greater than 4500 lb. per square inch at 28 days as assumed in the calculations.

Casting the Slabs.

The casting of the slabs was carried out as follows.

(1) The foundation was constructed to

placed for the ground floor slab; the mesh supports the conduits, sleeves, and prestressing cables which are wired to it. The ground floor slab was then cast. (6) The same procedure was followed for the three upper floors and the roofs. (7) When the concrete had attained a strength of at least 3600 lb. per square inch the prestressing cables were tensioned and grouted.

Lifting the 3labs.

The method of connecting the collars to the columns is shown in Fig. 2. The collars were placed over each column and the slabs cast so that they engaged the collars. Lifting rods were connected to the collars, and the slabs were lifted into place. The previous procedure was to secure the slabs in their final positions

with the lifting equipment until the steelplate shear-blocks, which normally support the slabs, were welded to each column; this immobilised the lifting equipment during the welding operation. On this building the slabs were lifted into place and pins of 11 in. diameter were fastened through shear-blocks to carry them. It was not necessary, therefore, to support the slabs with the lifting equipment while the welding was done. Most of the welding was done after all the slabs were lifted.

In order to provide a rigid connection to the column at the top of the casting. steel wedges (Fig. 2) were driven between the castings and the columns and welded in place. The pinned shear-plates at the bottom of the castings were welded to the collars and the columns to ensure rigidity ; this reduced considerably the time needed for welding and lifting.

The lifting of the slabs was carried out

as follows (see Fig. 3).

(1) After the jacks were placed on top of the lower halves of the columns and the lifting rods threaded into the holes in the castings, the roof of the solarium was raised. The shear-blocks were pinned temporarily near the top of the lower halves of the columns, and wedges were

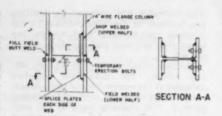


Fig. 4.-Detail of Column Splice.

driven into place from below and tack welded.

(2) The main roof was then raised, the shear-blocks pinned, and wedges installed from below. All the wedges were lightly tack-welded in place.

(3) Four bracing cables were then fastened simultaneously to anchors embedded in the four corners of the roof (stage 2). The other ends of the cables were secured to four concrete anchors in the ground. Turnbuckles on each cable were simultaneously tightened.

(4) The third floor was raised in the same manner, and the shear blocks pinned, followed by the second floor.

(5) The first floor and ground floor were raised to their positions, the shear-blocks

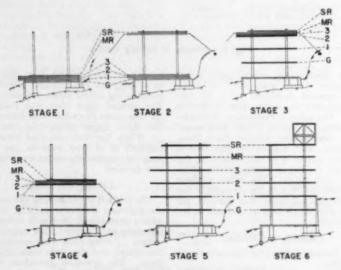


Fig. 3.-Stages in the Lifting Operation.

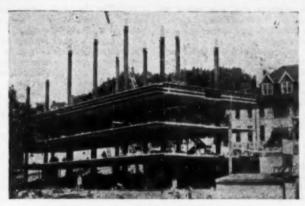


Fig. 5 .- Start of Second Lifting Operation.

pinned, the wedges installed, and the wedges and shear-blocks welded as shown in stage 3. During the lifting of the slabs the maximum horizontal displacement was $\frac{7}{8}$ in. at one end. At stage 3 the columns were again plumb.

(6) The jacks were removed from the tops of the columns, and the welding was completed at ground, first, and second floor levels.

(7) When the welding of the shearblocks was completed for the ground, first, and second floors, and the wedges had been welded for the ground and first floors, the bracing cables were transferred from the main roof to the second floor and tensioned as in (3).

(8) The extensions to the columns were erected and plumbed, and the splices welded (stage 4). Care was taken in welding at the splices so that shrinkage did not cause the columns to be out of plumb. Both flanges of the columns were welded simultaneously. The maximum deviation of any column from the vertical during welding was \(\frac{1}{2}\) in., which disappeared when the welds cooled. Details of the splice are shown in Fig. 4.

(9) Lifting jacks were placed on top of the extended columns (Fig. 5).

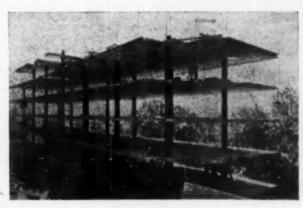


Fig. 6.-All Slabs in Place.

(10) The solarium roof was raised to the final position, the shear-blocks pinned, the wedges installed, and the wedges and shear-blocks welded.

(11) The main roof and the third floor were raised to their final positions, pinned, wedged, and welded (stage 5); this stage can be seen in Fig. 6.

(12) The wedges at the second floor were installed and welded from the top.

(13) The jacks were removed while the welding for the upper slabs was completed.

(14) The tops of the columns were burned off slightly below the surface of the roof and plates were welded on to receive insulation and topping. The frame of the penthouse was erected as indicated in stage 6. (15) The bracing cables were maintained in place until the end walls were built up to the second floor.

The placing of reinforcement and concrete required about a week for each slab. Lifting and splicing required 34 weeks.

The use of prestressing and lifting was estimated to result in a saving of about 20 per cent. of the cost of conventional construction using mild steel reinforcement and flat-slabs cast in place.

The architects were Messrs. Sherwood, Mills & Smith; the general contractors were Messrs. A. F. Peaslee, Inc.; the prestressing consultants were Freyssinet, Inc.; the lift-slab contractor was the New England Lift Slab Corporation. The foregoing is abstracted from the Journal of the American Concrete Institute.

II.—BUILDINGS IN GREAT BRITAIN.

Single-storey Warehouse.

The roof of a building for Messrs. Robert M. Douglas (Contractors) Ltd., at Birmingham, was the prototype of liftslab construction in Great Britain and was erected in order to carry out tests before larger structures were erected. The roof. the area of which is about 13,000 sq. ft., is divided into five sections, each section containing eight to twelve columns. A different separating medium was used under each slab to compare the various compounds available. The roof is an 8-in. solid flat-slab supported on precast concrete columns 8 in. square. Connection to the columns is made by means of fabricated steel collars using shear-blocks welded to inserts cast in the column, and similar to that illustrated in Fig. 7. Fixity at the bases of the columns is obtained by casting a pocket in the foundation base, erecting the column in the pocket, and filling the surrounding space with expanding grout. The erection of this building was used to train a team of operators for service on further works. The last slab was erected in 100 minutes, which represents a rate of lifting of about 8 ft. per hour.

Three Nine-storey Blocks of Flats.

Three blocks of flats for the City of Birmingham were the first lift-slab contract in this country. The 61-in. slabs, 75 ft. by 47 ft., were divided into two sections for lifting, each section containing

twelve steel stanchions comprising 10-in. × 10-in. and 8-in. × 8-in. universal sections, the weight per foot varying up the height of the building. The collars are the usual fabricated steel type.

The structural design generally followed the recommendations for flat-slabs in B.S. Code No. 114; lift-slab construction, however, involves consideration of a number of points not encountered in the design of buildings constructed in the ordinary manner. For example, during lifting, the slabs are supported simply by the lifting rods and are capable of rotation about the points of support. Therefore a separate moment-distribution operation is performed for the conditions during lifting, considering the slab to be freely supported and carrying its own weight only. After the slabs have been welded into position, the stanchions exercise restraint, so when carrying out momentdistribution operations for the final conditions the stiffnesses of the stanchions are considered. Imposed dead loads and live loads are separated, and the most adverse dispositions of the live load are considered. Consideration is also given to the possible stresses due to the chance of the slab being at different levels at the various columns during lifting. The strength of the stanchions, and in particular their resistance to buckling, had to be investigated carefully at all stages of lifting, and the Euler formula was employed for this purpose. The foundations differ little from ordinary foundations except that it

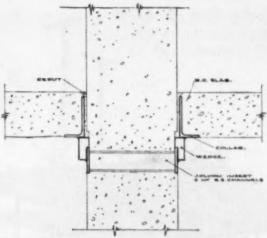


Fig. 7.-Connection for Concrete Column,

is essential to provide a rigid connection between the base of the stanchions and the foundation in order that the assumed condition of fixity at the base is obtained.

condition of fixity at the base is obtained.

Lifting the slabs in the first block of flats took about seven weeks but that of

the third block took just under four weeks. One of the blocks is shown in the course of construction in Figs. 8 and 9.

Some lifting took place in very cold weather; with lift-slab construction there are not the delays, consequent upon low

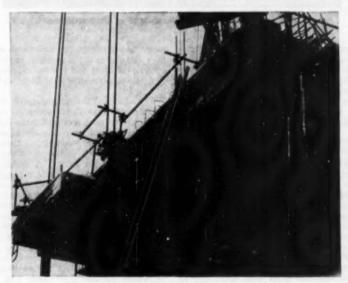


Fig. 8.-Northfield Flats: Five Slabs Lifted.

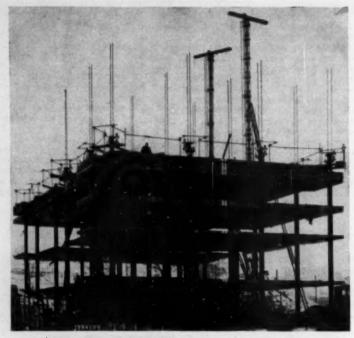


Fig. 9.-Northfield Flats in Course of Construction.

temperatures, to which cast-insitu construction is prone.

The buildings were designed by the City Architect, Mr. A. G. Sheppard Fidler. The structural design was carried out by Messrs. Robert M. Douglas (Contractors), Ltd., in conjunction with British Lift Slab Ltd.

Factory and Office.

The two buildings for Texas Instruments Ltd., at Bedford, comprise a singlestorey factory and a three-storey office block.

Universal steel stanchions are provided in the office block. The slab in this part is about 250 ft. × 50 ft., and was divided into three sections for lifting, each section containing twelve stanchions. Calculation showed that it was necessary to provide bracing along the weaker axis of the stanchions in the central row. In one section, the slabs were lifted one at a time to their final positions. In the

other two sections, the first- and secondfloor slabs were lifted together to the level of the first floor, and the second-floor slab was lifted after the first-floor slab had been fixed.

The slab in the single-storey factory was divided into thirty-seven sections of various sizes, each section containing from six to twelve reinforced concrete columns, which were more economical than steel stanchions in this instance. The height of lift was about 11 ft. A special steel helmet, to which the shear-blocks are welded (Fig. 10), is incorporated on each column. Steel straps fitted to the inside of the helmet transfer the load from the shear-blocks to the concrete of the column.

The architects are Messrs. O'Neil Ford & Richard Colley of the U.S.A. The consulting engineers are Messrs. Oscar Faber & Partners. The general contractors were Tarmac Civil Engineering Ltd., to whom British Lift Slab Ltd. were subcontractors. [At this factory some of

The £.s.d of OSAL* -Hardening and Oil Resisting for Industrial Floors

It's
not
the cost
per gallon
but
the cost per yard
that counts

On this basis Tricosal, which hardens and provides increased oil resistance for a cubic yard of I: 2: 4 concrete for only I4/-, is the most economical as well as the most efficient additive. It enables the concrete to be trowelled to a finish without an additional topping. It hardens integrally and, being a liquid, mixes with the gauging fluid and is evenly distributed throughout the mix.



Tricosal is no available in nor returnable cor tainers. For 30 years or more Tricosal has been specified by leading Architects not only for hardening and oil resistance but for waterproofing cement and concrete and increasing their resistance to acids. Send for Information Leaflet No. 1.

*OSAL is the generic name for the products of A. A. Byrd & Co. Ltd.—"Florosal" for Surface Hardening and protection of Concrete, Stone and Cement—"Neocosal" for Surface Waterproofing of Brick, Concrete and Stone, and "Tricosal". Literature on each individual product is available from

A. A. BYRD & CO. LTD. (Dept. C.6), 210 Terminal House, Grosvenor Gardens, London, S.W.I. Phone: SLOane 5236

Grams: Byrdicom Wesphone, London

Works: Basingstoke, Hants.

Pattern of service in the concrete age

Three Fold Service

Modular affer the combined services of consultation, design, manufacture and erection.

Modular will manufacture and erect to your designs.

Modular are specialists in precast structural concrete combined with integral finishes.

Whatever your concrete problem, the Modular Concrete Company's practical experience and technical resources are at your service.



Working to schedule

Modular Construction Division specialises in foundations and frames for all types of buildings. These two eight-storey blocks for the Croydon Borough Council, were erected in twenty weeks. Design: A. F. Holt, A.M.I.C.E. Burough Engineer Croydon

SPECIALIST ENGINEERS & CONTRACTORS

THE MODULAR CONCRETE CO. LTD. (Construction Division) 1260 London Road, Norbury, S.W.16. Tel: POLlards 5000

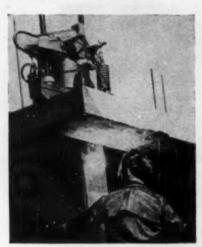


Fig. 10.—Factory at Bedford: Welding Shear Blocks.

the roofs are of hyperbolic-paraboloidal construction and are described in this journal for August 1960.]

A Large Car-parking Building.

One of the largest lift-slab projects yet attempted, which will also be the largest



Fig. 11.—Inspection of Jack. (Jack is fully extended: 3 in.)





Fig. 12 .-- A Jack on a Concrete Column.

multi-storey car-parking building in the world, is under construction for the Austin Motor Co., Ltd., at Longbridge, Birmingham. The building is of the parking-ramp type and the slabs are cast and lifted on a slope of 1 in 36. The building is 400 ft. by 200 ft. and is of nine storeys. Each slab is divided into twelve sections for lifting, each section containing twenty-one columns. The project involves the lifting of about 600,000 sq. ft. of 9-in. slab. The columns are of precast concrete and are to be erected in three sections. Connections are made by means of ordinary collars, wedges and fabricated steel inserts.

The architects are Messrs. Harry W. Weedon & Partners. The structural design and construction is by British Lift Slab Ltd.

Separating Media.

The suitability of the material used between the successive slabs is important. In the U.S.A. practice varies. The con-

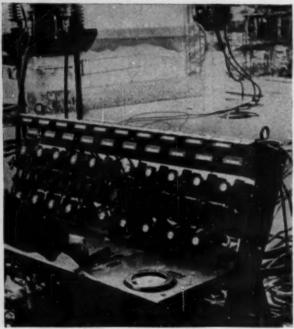


Fig. 13.-Control Console.

clusion* reached from the results of tests made in this country is that different media may have to be employed on each building according to its type and the programme of construction. The media vary in time of drying, chemical composition, and the like, and the requirements are that a suitable medium should prevent bond between the new concrete and that previously placed; that it should dry quickly; that it should resist the effects of wear and damage likely to be caused by workmen when placing reinforcement on the slab; that it should be weatherresistant; that it should be easily removed (or preferably should oxidise) after the slabs have been lifted, or alternatively be able to take the specified surface finish on the floors and ceilings of the slabs; that it should be reasonably cheap and easy to apply; that it should not stain the concrete permanently, and that the colour

e"Lift Slab Design and Construction." By F. R. Benson. Reinforced Concrete Review, December 1960. (Fig. 7 is reproduced from this source.) should fade early and easily; and that it should not react chemically with the concrete.

No one material satisfies fully all these requirements. The relative importance of each requirement varies from job to job; therefore a different medium may be required in each case.

Most separating compounds consist of a resin or a wax dissolved in a volatile spirit, which evaporates after application, leaving a thin hard film on the surface. Other media are sheets of building paper or polythene, the advantage of which is that as soon as they are laid on a slab, workmen can commence placing reinforcement for the next slab. The disadvantage of sheeting is that it tends to form corrugations in the soffit of the slab.

Lift-slab Construction.

The types of jacks used in Great Britain are illustrated in Figs. 11 and 12, and the console from which the movements of several jacks are controlled by one operator is shown in Fig. 13.



Photographs of Tunnel Work in progress and Segment Moulds used

By kind permission of HOWARD FARROW LTD.

CONSULT



FOR TUNNEL SEGMENT MOULD

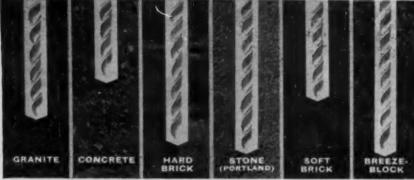
AND MOVING FORMWORK FOR TUNNEL LININGS

specifically designed to suit your requirements



the most comprehensive mould service in the world

STELMO LTD · WESTWELL LEACON · CHARING · ASHFORD · KENT. Tel: Charing 393-7



2 in. penetration I.3/6 in. penetration 2.3/6 in. penetration 2.5/6 in. penetration in 3 minutes in 36 seconds in 36 seconds in 36 seconds in 36 seconds

RAPID CLEAN POSITIVE PENETRATION

Ninety seconds to drill a clean 3/8 in. hole 1 in. deep in hardest granite—that's the fantastic penetration speed of the new "Rotopunch".

The sheer efficiency of the "Rotopunch" for rapid percussive drilling of all constructional materials is incomparable.

There's never been a tool like the "Rotopunch" . . . low in cost, high in all-round productivity . . . with its unique performance . . . absolute reliability . . . and low, well-balanced weight giving unusual ease of operation.

NERE IT IS AT LAST-the drill with the POWER to pierce granite...





ROTARY PERCUSSION DRILL

To: WOLF ELECTRIC TOOLS LIMITED
Dept. CCE, Ploneser Works, Hanger Lane,
London, W.S. Please send me the Plustrated leaflet on "ROTOPUNCH"
Company
Address

Mark for the attention of

AK24

AK24

Lift-slab construction has a number of self-evident advantages compared with ordinary cast-insitu construction. many cases significant reduction in the time of erection can be achieved by using lift-slab construction, since it is possible to cast successive floors at intervals of two days and lift a storey into position in a few hours, particularly in three-storey and four-storey construction. With higher buildings the speed per storey tends to decrease. The finishing and general building operations can commence as soon as a slab has been fixed in position and there are no delays waiting for concrete to harden and for the removal of shuttering. The greatest single advantage of lift-slab construction is the practical elimination of the shuttering for the soffit of floors; the only shuttering required is that around the periphery of the slabs and for blocking-out openings. A further advantage, which is enjoyed by all precast construction, is the elimination of the need to hoist concrete and reinforcement to high levels in multi-storey construction. It is possible in many cases to hoist building materials on the slab during lifting, resulting in economies in the finishing and building operations subsequent to the erection of the slabs. Casting all the slabs together at the ground floor enables protection from the weather to be more easily provided. Curing is carried out in suitable conditions as the slabs are quickly cast one on top of another and the separating medium acts as a curing membrane. As the concrete for each slab is deposited on to a trowelled surface, the finish of the soffit of the slab is of a sufficiently high standard to receive decorative treatment direct. Fewer operatives are required to work at the higher levels so accident risks are less. Another advantage of lift-slab construction is that the operation is quiet.

Training Courses in Concrete.

THE programme of training courses to be held during 1961 at the research station of the Cement and Concrete Association at Wexham Springs is as follows.

Structural concrete (for general foremen and clerks of works) .-- April 17 to 21 and May 1 to 5; also October 30 to November 24 (four courses).

Concrete roads and airfields (for engin-

eers) .- May 8 to 12.

Cement-stabilized road and airfield bases (for engineers).-May 15 to 19.

Concrete construction (for builders and estate developers).--May 29 to June 2 and June 5 to 9.

Structural concrete (for site engineers). June 12 to 16, June 19 to 23, and June 26 to 30.

Concrete for architects.- July 10 to 14, July 17 to 21, and July 24 to 28.

Concrete roads and cement-stabilized bases (for general foremen, clerks of works and highway superintendents). -- September 4 to 8 and September 11 to 15.

Concrete technology (for engineers) .-November 27 to December 1.

These courses are additional to the courses for concrete gangers (see this journal for February 1961).

Full details of the courses can be obtained from the Cement and Concrete Association, 52 Grosvenor Gardens, London, S.W.I.

Lectures on Building.

THE following lectures have been arranged by the Ministry of Works. Admission is

Prevention of Accidents in the Building Industry. By J. A. Hayward. College of Technology, Rotherham. March 15. 7.15 p.m.

Thermal Insulation of Buildings. By N. Foster. Technical College, Blackburn.

7.15 p.m.

Work Study in the Building Industry. By R. Geary. College of Technology, Sheffield. March 17. 7.15 p.m.

Prestressed Concrete. By H. Kaylor. Mining and Technical College, Wigan. March 20, 7.30 p.m.; and Technical College, Sunderland. March 28.

The Law and the R.I.B.A. Form of Contract. By I. N. D. Wallace. Technical College, Wrexham. March 21. 7 p.m.

Some Further Considerations of the R.I.B.A. Form of Contract. By I. N. D. Wallace. Mid-Warwickshire College of Further Education, Learnington Spa. March 22. 7.15 p.m.

Practical Formwork Design and Construction for Concrete. By J. G. Richardson. Cleveland Scientific and Technical Institution, Middlesbrough. March 22. 7.15 p.m.

Operational Research in Building. By J. F. Nuttall. Hertfordshire College of Building, St. Albans. March 23, 7.15 p.m.

Concrete Piers for the Tamar Road Bridge.

The new suspension bridge (Fig. 5) which is being constructed for the Tamar Road Bridge Joint Committee across the River Tamar between Saltash and Plymouth will have a main span of 1100 ft., two side spans each of 374 ft., and approach spans of 51 ft. at the western end and 84 ft. at the eastern end. There are four reinforced concrete piers which are now complete. The carriageway, which is 33 ft. wide, passes through the river piers. The two footpaths are 6 ft. wide, except where they pass around the outside of the river piers, where they are 8 ft. wide. The road is about 130 ft. above high water.

The piers on the eastern bank are shown in the course of construction in Fig. 1. The river piers are 240 ft. high, and are supported on vertical reinforced concrete cylinders founded on rock at depths of 30 ft. to 40 ft. The walls of the cylinders are 10 ft. thick and were cast in caissons of 30 ft. diameter. Some of the work in the caissons was done in compressed air.

All the columns are of hollow square cross-section with rounded external corners, and have walls 2 ft. thick. The columns of the river piers are 14 ft. square at the base and taper to 9 ft. square at the

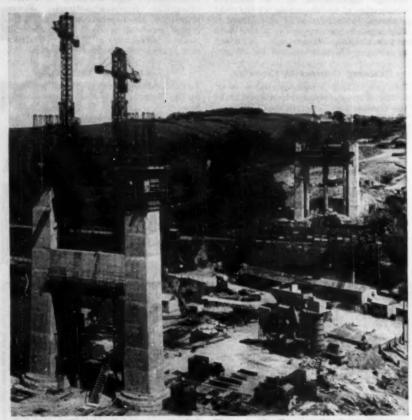


Fig. 1.-Arrangement of the Plant on the Eastern Bank.

BRITISH OXYGEN ARE PROPANE EXPERTS

The use of bulk propane is backed by the huge resources of British Oxygen. In practical terms, this means the free installation of bulk storage tanks: regular servicing of these installations and reliable delivery of BOC propane by tanker and in cylinders. British Oxygen experts estimate your propane needs—supply equipment—advise you on the advantages of using this resourceful fuel. Propane. Bought from British Oxygen.

Get on to the experts · BRITISH OXYGEN ring Hyde Park 7090

THE BRITISH OXYGEN COMPANY LIMITED Light Industrial Department · Spencer House · 27 St. James's Place · London S.W.1



school today . . . and tomorrow?

Tomorrow—new lands, new peoples, new cities.

AIRPORTS . . . DOCKS . . . BRIDGES . . . RAILWAYS . . .

These and many, many other projects

we build



109 Station Road, Sidcup, Kent

26 Victoria Street, London, S.W.I

BUILDING AND CIVIL ENGINEERING CONTRACTORS

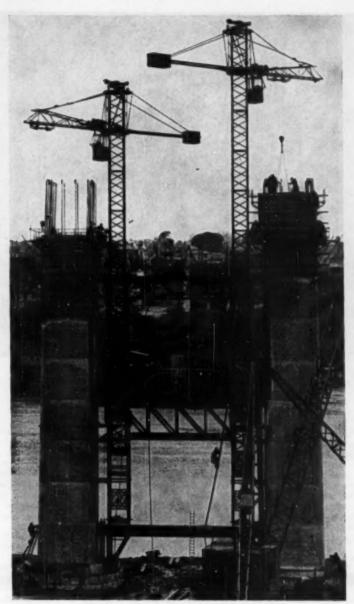


Fig. 2.—Construction of the Main Pier.



Fig. 3.—Transverse Beams between Columns.

top. The land piers have the same taper, one being 70 ft. high and the other 50 ft. high; the bases of these piers are 9 ft. 6 in. square and 8 ft. 6 in. square respectively. A transverse beam between the pair of columns of each pier supports the steel lattice girders of the bridge. The deck is of steel-beam and concrete-slab construction and spans between the main longitudinal girders.

The main constructional equipment is similar on each bank and comprises a batching plant, a jib crane, two tower cranes and a mobile crane for the batching plant. The arrangement of the plant is shown in Fig. 1.

Shuttering.

The concrete for all the piers was placed in shuttering constructed in lifts of 10 ft. Two sets of shuttering were provided for each column of each pier, one set being erected on top of the other while the concrete hardened in the lower lift. The shuttering (Fig. 4) comprised mainly standard panels constructed of steel frames with plywood sheeting. The shuttering for each side of a column was moved in one piece by the tower cranes (Fig. 2) which were mounted on the foundation of the piers. A reduction of 5 in. in the width of the column was made at each move by the removal or replacement of panels at one corner of the column. The lower lift of shuttering was supported by steel ties through the concrete walls of the columns.

The shuttering for the transverse beams between the columns is of the same type as for the columns but was supported, as shown in (Fig. 3), on steel beams supported on pairs of temporary vertical steel tubes.

EVERY ONE A WINNER

ALL MADE WITH THE SAME CEMENT CIMENT FONDU

THE CEMENT

FOR INDUSTRY

UNEQUALLED FOR SPEED, STRENGTH, RESISTANCE AND REFRACTORINESS

Send for a copy of 32-page Booklet "The Cement for Industry".

LAFARGE ALUMINOUS CEMENT CO. LTD. 73 BROOK STREET, LONDON, W.I

Tel. HAYfair 9546

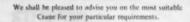
PINGON TOWER CRANES

again chosen by THE CLEVELAND BRIDGE & ENGINEERING CO. LTD.

for their

IMPORTANT

TAMAR BRIDGE CONTRACT



SOLE SELLING AGENTS IN THE UNITED KINGDOM

GEORGE COHEN

SONS AND COMPANY LIMITED WOOD LANE, LONDON, W.12

Tel: Shepherds Bush 2070

And at: Stenningley (near Leeds), Kingsbury (near Tarmsorth), Manchester, Glasgow, Swanses, Newcastle, Belfast, Sheffield, Southempton, Bath.



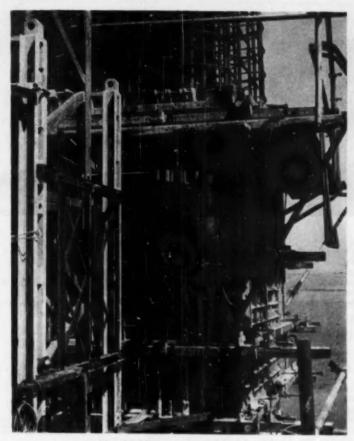


Fig. 4.-Shuttering for the Piers.

Cranes.

The cranes are climbing tower cranes modified to enable the cranes to be supported outside the columns, the cavity within the columns not being large enough to accommodate them. The normal type of frame for a climbing crane was replaced by a special frame constructed of steel bridge girders, of the Bailey type, anchored to the columns. The distance between the columns being 41 ft., it was necessary for one crane in each pair to be erected with its fixed jib above the other, resulting in towers 74 ft. and 84 ft. high.

The climbing frames were also used to carry a platform between the two columns of each pier, these platforms providing a working area for the construction to be carried out. As work progressed, more sections were added to the climbing frames on each column, and the platforms and cranes were raised by means of pairs of hand-winches mounted on the platforms.

The cranes were used not only for lifting the shuttering, but for lifting and placing the reinforcement and concrete. Although the working radius of each crane is 99 ft. it was necessary only to lift loads



Fig. 5.

at a radius of 27 ft. 6 in., at which distance the permissible load is 24 tons.

A two-way transistor loud-speaker communication system is installed so that men working on the towers and elsewhere can keep in touch with the site office.

The consulting engineers are Messrs.

Mott, Hay and Anderson. The general contractors are Cleveland Bridge and Engineering Co., Ltd.

The shuttering was provided by Kwikform. Ltd.

The tower cranes were provided by Messrs. George Cohen Sons & Co., Ltd.

Public Works Congress.

The following are some of the papers presented at the Public Works and Municipal Services Congress which was held in London in November 1960.

"A Survey of the Methods Used for Determining the Bearing Capacity of Piled Foundations." By T. Whitaker. (In conjunction with the Building Research Station.)

"Motorway Construction in Hertfordshire." By C. H. Ffolliott. (Under the auspices of the County Surveyors Society and the Institution of Municipal Engineers.)

"The Organisation and Construction of Public Health Works." By A. Osborne. (Under the auspices of the Institution of Public Health Engineers.)

"The Management and Operation of a Civil Engineering Contractors' Plant Depot." By J. H. Brass. (Under the auspices of The Institution of Civil Engineers.)

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY

BURSARIES IN CONCRETE STRUCTURES AND TECHNOLOGY

Bursaries of £460-£760 according to experience are available for Session 1951-1962. Candidates must held a degree in engineering and have a good knowledge of the theory of structures. Full information from the REGISTAR, Ingrand. COLLEGE, London, S.W.7. Closing date 1st June, 1967.

THE UNIVERSITY OF LEEDS

The University offers a one-year full-time course for a Diplema in Concrete Technology commencing in October, 1961. The course consists of lectures, laboratory work, and a design or research project.

Applications for admission to the course are invited from graduates and from bolders of equivalent qualifications in engineering. Preference will be given to applicants who have had one or two years' practical experience.

Further information may be obtained from THE REGISTRAR, THE UNIVERSITY, LEEDS, 2.

CELSIUS

[188

celsius See THERMOMETER (person)

celt 1. n., chisel-edged prehistoric tool (imaginary L.)

celt 2. n., (pl.) peoples speaking or having spoken languages akin to that of the Gauls (Bretons, Cornish, Welsh, Irish, Manx, Gaels) (sing.) member of such people.

celtie (adj.; -ically) of the Cc. (Celtic fringe, the Scots, Irish, Welsh and Cornish, in relation to the U.K.) (n.) the Celtic language, celticism, celtomania, celtomaniac, celtophobe, celtophobia, nn. (L. Celta)

cement 1. n.; Substance made by calcining lime and clay, applied as paste and hardening into stony consistence, and used as material for floors and walls and tanks or as mortar: TUNNEL C. is particularly strong, rapid hardening, weather resistant c. Best C. see The Tunnel Portland Cement Company Limited, 105 Piccadilly, London W.1 GROsvenor 4100.

cement 2. v.t. Apply c. to, line or cover with c., unite (as) with c. To C. for best results see TUNNEL

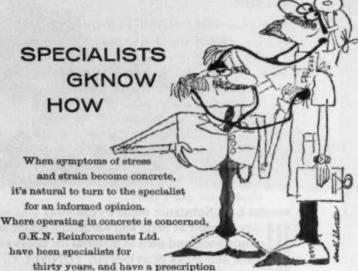
cemetery n., Burial ground other than churchyard (Gk. Koimao, put to sleep)

cenobite see COENOBITE

cenotaph (-ahf) h. Sepulchral monument to one whose remains are elsewhere.

censer n Incense-burning vessel. Cense v.t. adore or perfume with incense (INCENSE 2)

censor 1. n. Ancient-Roman supervisor of census and public morals: modern official examining plays, books, news, correspondence, etc. to suppress what is immoral or seditious or (esp. in war) inopportune person assuming the right of judging others. 2. v.t Examine or make excisions etc. as in c. Censorial a., (-lly), of



for most problems. "Gknow how" it might be said,
is not necessarily everything; the complete practitioner

is not necessarily everything; the complete practitioner also knows his client's local problems.

It's a real advantage to have branches all over the country which ensure that local gknowledge assists your operation and that steel deliveries are made to requirements.

If you want to put steel into concrete consult the specialists

GKN Reinforcements Ltd.

LONDON Chancery 1616
MANCHESTER Ardwick 1691

CARDIFF Cardiff 35220

GKN

SMETHWICK Smethwick 1991 GLASGOW Bell 2444

BRISTOL Bristol 21555

MIDDLESBROUGH Middlesbro' 3843 SOUTHAMPTON South'ton 82167

LEICESTER Leicester 95114

LEEDS Leeds 27311

Prestressed Concrete in France.

At a meeting organized by the Prestressed Concrete Development Group and held in London in January last, Monsieur Y. Guyon gave an address on "Recent Projects and Work in Prestressed Concrete" in France. Several types of structures were described including buildings, bridges, pipes, shell roofs, and

water-containing structures.

Among the interesting structures is a filter plant; the transverse ribs, which are at 10-ft. centres and between which the bottom slab spans, are supported continuously on resilient laminated pads which permit 1-in. lateral movement of the ribs and superstructure relative to the piled foundations during the prestressing operation. The pads comprise layers of rubber and steel-plate; the thickness is determined by the rule that the thickness, which is I in. in this case, should be twice the amount of the distortion.

A difficulty experienced with bridges incorporating cantilevered construction is that the ends of parallel cantilevers deflect by different amounts. This deflection has been avoided by causing the cantilever to rotate, in a vertical plane, at the pier by the insertion of prestressing cables by means of which the ends can be slightly raised or lowered as required. Another method is to provide a splayed joint at the root of the cantilever and to produce the necessary rotational movement again by means of prestressing cables.

A pipe-line in India comprises nearly 6000 ft. of pipes of 20 ft. internal diameter. The pipes are cast insitu and are prestressed circumferentially by post-tensioned cables in pairs at 12 ft. centres; one cable in each pair extends around the lower half of the pipe and the other around the upper half, the ends of the two cables overlapping sufficiently to ensure complete compression. Although the frictional resistance to movement of a cable of about 10 ft. radius is great, the method was found to be economical. The pipe-line is elevated in parts of its length to bridge over rivers, and on these parts the lower segment of the pipe is precast and two ribs project below the invert to provide sufficient strength to span between the supporting piers. The piers are up to 70 ft. high.

An unusual example of the use of flat-

Recent Developments of jacks is the case of a buttress dam. Compression is induced in the buttresses by flat jacks inserted between the root of the buttress and a short abutment bearing against firm ground in front of the dam.

Church and Campanile at Stevenage.

THE precast members in the church and campanile at Stevenage, which was described in our number for February 1961, were made by Messrs. Cawood Wharton Ltd. The bored piles were installed by Frankipile Ltd.

THE POLYTECHNIC REGENT STREET LONDON W.1

A one-week full-time course on COMPUTING IN CIVIL ENGINEERING from the 17th to 21st April 1961

Further particulars and enrolment forms may be obtained from the Head of the Department of Civil and Mechanical Engineering.

SENIOR ENGINEERS DESIGNERS AND DETAILERS FOR THEIR CHELMSFORD DRAWING OFFICE Apply THE BRITISH REINFORCED CONCRETE

ENGINEERING CO. LTD.

GROSVENOR STREET, LONDON, W.I

DATA FOR PRICING REINFORCED CONCRETE.

MATERIALS (Delivered London).

AGGREGATES (per cu. yd.).

Washed sand: 26s. 9d. Graded gravel (f in.): 24s. 3d. Pit ballast: 25s. 6d. CEMENT (per ton).

Ordinary Portland.—6 tons and upwards: 112s.; 1 ton to 6 tons: 124s.

Rapid-hardening Portland: As ordinary Portland plus 10s. 6d. "Aquacrete" and "417": As ordinary Portland plus 32s. 6d. "Colorcrete" (buff, red, and khaki): As ordinary Portland plus 60s. "Snowcrete" (white): 277s. 6d. "Super-Cement": As ordinary Portland plus 32s. 6d.

High-alumina cement.—I ton: 337s.; 2 tons: 327s. 6d.; 6 tons: 321s. 6d. "Super Snowcem" waterproof cement paint: 100s. per cwt.

REINFORCEMENT (per ton ex stock including delivery in quantities from 10 to 500 tons). Plain mild steel rods per B.S. No. 785.—I in. and over: £50 5s.; \$\frac{1}{6}\$ in. and \$\frac{1}{6}\$ in.: £51 15s.; \$\frac{1}{6}\$ in.: £53 7s. 6d.; \$\frac{1}{6}\$ in.: £54 17s. 6d.; \$\frac{1}{6}\$ in.: £58 17s. 6d. Hot-rolled deformed bars: As plain bars plus £1.

High-tensile (minimum yield point 44,000 lb. per sq. in.): As mild steel plus 19s.

(For basic prices and allowances for quantities exceeding 500 tons and extras for quantities less than 10 tons, lengths greater than 40 ft. or less than 5 ft., bundling, labelling, and delivery in other areas, see "Concrete Year Book, 1961".) Fabric per B.S. 1221A (per sq. yd.).—No. 109: 3s. \(\frac{1}{4}\).; No. 121, 5s. 7\(\frac{1}{4}\).; No. 124:

3s. 4ld.; No. 125; 2s. 10d.; No. 126; 2s. 6ld.

TIMBER.—Sawn deal shutter boards: £95 to £100 per standard (165 cu. ft.); 1-in. boards: 1s. (av.) per sq. ft.; 11-in. boards: 1s. 31d. (av.) per sq. ft.

MATERIALS AND LABOUR.

Based on net cost of materials plus 10 per cent, and net cost of labour plus 45 per cent. for insurances, etc. (10 per cent.), on-costs (22 per cent.) and profit (10 per cent. on gross cost = 13 per cent. on net cost). No allowance for non-productive ordinary time. overtime, travelling time, fares, subsistence, etc. Wages (per hour).—Carpenters and joiners: 5s. 14d.; labourers: 4s. 6d.; mixer and hoist operators: 5s.; bar benders: 4s. 111d. PORTLAND CEMENT CONCRETE (1:2:4).

Foundations (per cu. ft.).-3s. 6d.

Suspended slabs (per sq. yd.).-6 in., 18s.; 7 in., 21s.; 9 in., 27s. 2d.

Beams (per cu. ft.) .- 45. Columns (per cu. ft.).-4s. 6d.

Walls (per sq. yd.).-6 in., 19s. 9d.; 9 in., 29s. 6d.;

12 in. and over (per cu. ft.), 3s. 6d.

Extra (per cu. yd.) for rapid-hardening Portland cement. 1:2:4.—2s. 8d.

REINFORCEMENT.-Mild steel rods cut, bent and fixed (per cwt.)

	In floor slabs and beams	In columns.	In walls.	Stirrups, binders, etc.
1 in. and over	74s. 9d.	80s. 5d.	78s. 1d.	ment
I in. and I in.	75s. 7d.	81s. 3d.	78s. 11d.	
in.	76s. 5d.	82s. 1d.	79s. 9d.	
in.	83s. 11d.	90s. 8\d.	88s. 6d.	
in.	85s. 6d.	92s. 3d.	90s. 1d.	108s. 7d.
∦ in.	87s. 9d.	94s. 6d.	92s. 4d.	104s. 10d.
in.	88s. 10d.	oss. 8d.	938. 5d.	104s. 11d.

Fabric per B.S. No. 1221A in flat areas (per sq. yd.) including straight cutting.— No. 109: 4s. 4d.; No. 121: 7s. 11d.; No. 124: 4s. 9d.; No. 125: 4s. 1\dd.; No. 126: 3s. 6\d. SHUTTERING (FORMWORK).-Assuming five uses of wooden shutters for floor soffits and walls, and three uses for beams.

Soffits of floors, flat roofs, etc. (per sq. yd.): 16s. 3d.; ditto sloping: 18s. 1d. Walls and partitions (per sq. yd.): 19s. 11d.; ditto curved: 26s. 10d. Rectangular beams, lintels, columns, etc. (per sq. ft.): 2s. 8d.; ditto circular: 3s. 8d.

This page is prepared specially for "Concrete and Constructional Engineering" and is strictly copyright.

MISCELLANEOUS ADVERTISEMENTS.

Situations Wanted, 5d. a word: minimum, 12s. Situations Vacant, 6d. a word: minimum, 15s. Other miscellaneous advertisements, 6d. a word: minimum, 15s. Displayed advertisements, 40s. per column inch. Box number 1s. extra.

Advertisements must reach this office, 14 Dartmouth Street, London, S.W.1, by the 36th of the month preceding publication.

SITUATIONS WANTED.

SITUATION VACANT. Reinforced Concrete Engineers require Draughtsman for Project and Estimating Department at Head Office, Harrow. Write full details to BIERRUM & PARTHERS, 167 Imperial Drive, Harrow.

SITUATIONS VACANT. Reinforced concrete designers and detailers required for industrial and framed structures. Structural steelwork an advantage. Salaries £800-£1100 according to age and experience to right men, who need to be quick, competent and conscientious. Five-days' week. Luncheon vouchers. Interviews evenings and Saturdays. R. L. BOUNGUI & PARTHERS, 85-87 Clarence Street, Kingston-upon-Thames. Telephone: Kingston 0877/0285/0323. Evenings: Elmbridge 2654.

R. L. BOURQUI & PARTHERS, 85-87 Clarence Street, Kingston-upon-Thames. Telephone: Kingston 0877/0285/0323. Evenings: Elmbridge 2654.

SITUATIONS VACANT. Consulting engineers have vacancies for the following: Reinforced concrete designers with A.M.I.Struct.B.; Designer-detailers with H.N.C. or similar; Detailers with minimum two years' experience. The positions are permanent, with opportunity for advancement. Modern office and pleasant conditions. Salaries in accordance with experience. ByLANDER, WADDELL & PARTHERS, 169 Wendbley Park Drive, Wembley.

STUATION VACANT. Draughtsman-detailer for reinforced concrete urgently required. Good prospects with a scope for design work. Please apply to The Engirement Design & Construction Co. Ltd., Ardshiel House, Empire Way, Wembley, Middlesex. Telephone; WEMbley 0424.

SITUATIONS VACANT. Designer-detailers and detailers required for interesting work in a happy office. Permanent appointments. Unusual methods of detailing taught. Fair pay and luncheon vouchers. M. M. Khan, B.Sc., M.I.C.E., 88 Rochester Row, London, S.W.r. VICtoria 9538.

SITUATIONS VACANT. Designer-detailers and detailers with a minimum of four years' experience in reinforced concrete are invited to apply for progressive poets in consulting engineer's office in Westminster. Apply A. E. Beer, 96 St. George's Square, London, S.W.I.

SITUATIONS VACANT. Draughtsman and junior draughtsman required by specialist glass and ferro-concrete company. Knowledge of building construction essential. Bonus and non-contributory pension schemes. Five-days' week. Write or phose details of experience, age, salary required, to Lenschere Ltd., Queen's Circus, London, S.W.S. MACaulay 1063.

SITUATIONS VACANT. Reinforced concrete designen-detailers, senior and intermediate, required by consulting engineers. Commencing salary up to £1100 p.a. Luncheous vouchers. Pension scheme. Eoward A. PITCARR & PARTHRIS, 12 Queen, hithe, Londow, E.C.4. CENTRIS 981. SITUATIONS VACANT. A design and detailing team is required for work on reinforced concrete, steel and timber structures. Applications are invited from capable designers and detailers between the ages of 25 and 30 years. Salaries from £1000 p.a. upwards for the right men. Vacancies also exist for men 21 to 25 years of age. Write to D. W. Cooper, 165 Westmorland Road, Newcastle upon Tyne. 4.

apon Tyne, 4.

SITUATION VACANT. Qualified engineer-designer required by London consulting engineers. Good background of drawing office and other experience in reinforced concrete work are essential. Work will be primarily in drawing office, but successful applicant will assist executive with technical administration work, organisation correspondence, accounts, estimating, etc. Good prospects for smart and alert applicant who can take things as they come. Starting salary about £1250. Applications, with full details in confidence, to Box 4737, Concrete and Constructional Engineering, 14 Dartmouth Street, London, SW.1.

Truscon

Applications are invited from reinforced concrete designers, detailers, and draughtsmen for vacancies which exist at a number of our structural design offices. We are looking for men with first-class experience who will help to maintain our own tradition of quality, combined with speed and economy. In London, in particular, designer applicants should have had good experience of, and an aptitude for, project work. Address your letter personally to one of the following:

V. Weber, B.Sc., A.C.G.I., M.I.C.E., M.I.Struct.E.,

Truscon House, 35/41 Lower Marsh, S.E.1.

HARLOW P. B. Wood, B.Sc.(Tech.), A.M.I.Struct.E., 13 Market House, Stone Cross, Harlow.

BIRMINGHAM B. W. Cooper, B.Sc., D.I.C., A.M.I.C.E., George House, George Road, Edgbaston, Birmingham 15.

MANCHESTER H. Heller, B.Sc., A.C.G.L., A.M.I.C.E., 50 Seymour Grove, Manchester 16.

GLASGOW W. H. Sneddon, M.I.Struct.E., 10 India Street, Glasgow C.2. expanding company

• good reputation

progressive approach

good salaries

profit-sharing scheme

pension scheme

good holidays

• free sick pay scheme

• five day week

• overtime paid

 opportunities for advancement

security

SITUATIONS VACANT. Design-detailers required, preferably qualified but minimum standard H.N.C., with several years' drawing office experience in reinforced concrete. Age range 25-40 and able to work on own initiative. Applications in writing to Joss Liversedor & Amountares, 42 Portland Place, London, W.I.

& Amociares, 42 Fortland Place, London, W.I.
SITUATIONS VACANT. Reinforced concrete draughtsmen-detailers required by West London consulting
engineers dealing with hospitals, flats, schools, etc. Permanent positions. Excellent prospects with opportunities
for design. Five-days' week. Superannuation. Only men
with experience should apply. Telephone Bayawater 8587

SITUATIONS VACANT. Well-established consulting engineers specialising in reinforced concrete work require two senior engineers capable of taking charge of sections. Applicants must be A.M.I.C.E. or A.M.I.Struct.E.—B.Sc. perferred. Opportunities for partnership. Daly well-experienced people with an interest in imaginative design need apply. Applications will be treated in strict confidence. Five-days' week. Superannuation. Box 4735. CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.I.

SITUATION VACANT. Chief structural engineer, specialising in reisforcood concrete design, commencing salary £1,500-£2,000 p.a. (liacreased subject to merit thereafter), required by leading consulting structural engineers for Glasgow office. Applicants must be A.M.I.C.B. or A.M.I.Struct.B. and preferably be born and educated in Scotland. Age 35-45 years. Applicants must have had several years' experience in full charge of design offices. Pension scheme available and assistance with housing would be considered. Applications, which will be treated as strictly confidential, and marked on envelope "Confidential—Chief Engineer", to Box 4734. CONCERTE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.I.
SITUATIONS VACANT. Reinforced concrete designer, designer-detailer and detailer-draughtsman with experience required by consulting engineers, London, W.I. Good

SITUATIONS VACANT. Reinforced concrete designer, designer-detailer and detailer-draughtsman with experience required by consulting engineers, London, W.I. Good prospects. Interesting work. Luncheon vouchers. Fivedays' week. Salary [750 upwards, according to position. Apply Box 4738, CORCRETE AND CONSTRUCTIONAL ENGINEERING, 14 DETMONTH STEET, LONDON, S.W.I.

SITUATION VACANT. Senior engineer required to take charge of reinforced concrete contractors' design office. Permanent position for qualified man. Good salary. Profit-sharing and pension scheme. F. Bradpond & Co. Ltd., Angel Road, Edmonton, London, N.18.

ARTEK (U.K.) LTD.

require in

BOURNEMOUTH

additional structural staff:

Designers and detailers experienced in reinforced concrete, for permanent posts in expanding office. Interesting and varied work; modern offices; excellent conditions and prospects. Interviews London or Bournemouth (expenses paid). Apply, fullest details, to Royal London House, Lansdowne, Bournemouths.

SINDALL CONCRETE PRODUCTS LTD

wish to appoint a

REINFORCED CONCRETE

DESIGNER-DETAILER
for interesting and varied work in simple reinforced
concrete design and detailing, together with administration of contract works.

Excellent conditions and prospects in an expanding concern for suitable candidates showing initiative and readiness to assume increasing responsibility.

Apply in writing, giving particulars of age, experience and other relevant details, to

> SINDALL CONCRETE PRODUCTS LTD., 347 Cherry Hinton Road, Cambridge.

CONCRETE DESIGNERS

The Stanton Ironworks Company Limited has the following vacancies

SENIOR REINFORCED CONCRETE DESIGN ENGINEER

The successful applicant will take charge of the section of the drawing office in which the design of reinforced and prestressed concrete products and associated work is undertaken. He should be capable of working on his own initiative and will preferably have graduated or hold an equivalent technical qualification, and have had at least three years' experience on the design of concrete structures or precast concrete products.

ASSISTANT REINFORCED CONCRETE DESIGNER

This appointment offers an excellent opportunity for a young engineer or draughtsman to widen his experience under the supervision of a senior designer. The minimum technical qualification is Higher National Certificate, and applicants must be capable of quick and accurate work.

Both positions are progressive and pensionable. A five-days' week is worked. Write, in confidence, with details of age, qualifications and experience, to

The Staffing Officer,

THE STANTON IRONWORKS COMPANY LIMITED

P.O. Box No. 3, near Nottingham SITUATION VACANT. Production manager required by The Chopt Granter, Brice & Concert Co. Let., to relieve their London Director of detailed responsibility for production of hydraulically-pressed products at their Erith works in London. Applicants should be between 28 and 45, preferably with a good mechanical or civil engineering background and some previous experience of production of concrete products. Applications, with details of past experience and present salary, to the Managing Director, Croft, near Leicester.

SITUATION VACANT. Senior civil engineer required with experience of prestressed conscrete design or construction. Must be A.M.I.C.E. or A.M.I.Struct.E. The successful applicant must be prepared to travel in U.K. and overseas to advise on the design and use of C.C.I. systems. Specialised training will be provided. This is a new post created by the rapid expansion of the company. Office situated Surbiton, Surrey. Applications, stating experience, and salary required, to the CHIEF CIVIL ENGINEER. CABLE COVERS LTD., St. Stephen's House, London, S.W.I.

TAYLOR WOODROW CONSTRUCTION LIMITED



for

CIVIL ENGINEERING RESEARCH

require

TWO SENIOR ENGINEERS to undertake responsible roles in a very interesting programme of research and development into the application of concrete, including prestressed concrete, to nuclear power,

A SENIOR REINFORCED CONCRETE DESIGNER with considerable experience in advanced structural design.

A SENIOR RESEARCH CIVIL ENGINEER with a good academic background particularly in theory of structures and mathematics.

Applicants, preferably with good Honours Degree in Civil Engineering, should either telephone Dr. K. Billig, WAXIow 2366, or write to the

PERSONNEL MANAGER

345 Ruislip Road, Southall, Middlesex

LAING

JOHN LAING CONSTRUCTION LIMITED require

ENGINEERS

for general site engineering services. Applications are invited from qualified and part-qualified men and from men with good instrument experience. This is an opportunity to join a well-integrated team with permanent and pensionable employment with the Company.

London N.W.7

Apply, giving details of past experience, to:

The Group Personnel Manager (PRB/S.E.4),

JOHN LAING AND SON LIMITED

PRECAST CONCRETE WORKS

MANAGER

The directors of an old-established company in Co. Durham seek a manager for present works under new expansion programme.

Applicants should have had responsible experience in a similar works, with good working knowledge of works management including estimating, costing, labour control, production and works installation.

Some knowledge of reinforced concrete design and experience of prestressing would be an advantage. Good prospects depending upon ability, and excellent salary.

Write for interview, with particulars and experience, to Box 4739, Concrete and Constructional Engineering, 14 Dartmouth Street, London, S.W.1.

OVE ARUP & PARTNERS

have vacancies in their

LONDON, MANCHESTER, SHEFFIELD and EDINBURGH offices for experienced Engineers, Designer-detailers and Detailers

for work on a number of contracts of considerable scope, interest and variety, including:

The Barbican Re-development. The rebuilding of Smithfield Market. The new Opera House at Sydney, N.S.W. and new work for Universities, Hospitals and Multi-storey car parks, etc.

Interviews will be arranged as convenient. Applications, giving details of qualifications, experience, etc., to 13 Fitzroy Street, London, W.I.

CIVIL ENGINEERING DESIGNER required by

NORTH THAMES GAS BOARD

at Monck Street. WESTMINSTER SWI

for the design and detailing of reinforced concrete sortic trees, and foundations associated with gas structures, and foundations associated with gas works. A knowledge of river walls and jetties would also be an advantage.

Candidates should possess the Higher National Certificate as a minimum qualification, and membership of an appropriate institution is desirable. Commencing salary will be within the range £1,035 to £1,300 per annum according to qualifications and experience.

The appointment will be of a permanent nature and there is scope for future advancement. The successful candidate will be required to join the Board's staff contributory pension scheme.

Applications, stating age, qualifications and experience, should be sent within ten days of the appearance of this advertisement, quoting reference CG/1, to

> THE STAFF CONTROLLER NORTH THAM: GAS BOARD Kensington Church Street London W8

OPPORTUNITY

for ambitious able young engineers with good degree and sound experience in reinforced concrete design gained on the drawing board and site to express their imaginative ideas in structures of individual character. The right men will be about express their imaginative ideas in structures of individual character. The right men will be about 30, good mixers, but nevertheless of strong person-ality and able to lead a team under a partner or associate. Commencing basic salary between £1,300 and £1,300 which, with other allowances and merit bonuses, should result in gross earnings of £1,500 to £1,800 in permanent pensionable and progressive positions. Brief particulars in first instance in own handwriting to Charles Wilso. AND PARTNERS, 123 King Street, Hammersmith, London, W.6.

DETAILERS

with sound experience in reinforced concrete and some knowledge of simple design wanted by Charles Werss and Partricine, 123 King Street, Hammersmith, London, W.6. Those studying for professional examinations will be given assistance. Pensionable appointments with regular salary increases on merit. Basic commencing salary floor of force, but allowances and bonues based on ability and diligence may add another first to fayot the basic salary. Please write in the first instance in own handwriting to the address given above. above.

SITUATION VACANT. Senior engineering assistant experienced in reinforced concrete and steel design required for London professional office. Must have degree and/or professional qualifications and at least 6—10 years' experience. Should be capable of assuming full responsibility for design and administration of contracts and will be expected to supervise junior staff. The work is varied and offers scope for initiative. Apply, stating full particulars and salary required, to Fanker & Dark, Romney House, Tufton Street, London, S.W.I.

House, futton street, Lensus, S. W. S. STIUATION VACANT. Designer-detailer experienced in reinforced concrete required for London professional office. The work is varied, comprising all types of construction in concrete and steel, and offers scope for anyone interested in gaining design experience. Permanent position with excellent prospects. Five-days' week. Apply, stating full experience, to Farings & Dark, Romney stating full experience, to FARMER & House, Tufton Street, London, S.W.I.

designer detailers experienced in reinforced concrete required in new specialist design office in Southampton. G.K.N. REINFORCEMENTS LTD. SITUATIONS VACANT. Designer - engineers Southampton

SITUATIONS VACANT. Reinforced concrete engineers and contractors require draughtanen, experienced in detailing, for Contracts Department at Head Office, Harrow. Write, giving full details, to BHERKUM & PARTMERS, 167 Imperial Drive, Harrow.

CHIEF ENGINEER

ng in reinforced concrete structural design, A.M.I.C.E. or A.M.I.Struct.E., to take sole charge of and build up new drawing office now open in centre of Birmingham.

A wonderful opportunity to join a leading and expanding group of comp For further information write, in confidence, to

I. E. LEHNARD. RICHARD HILL LTD.,
7 Cleveland Row,
St. James's,
London, S.W. I.
Telephone: WHitehall 3100. SITUATIONS VACANT. Consulting engineers require senior detailers and detailers for interesting structural work in reinforced, prestressed and precast concrete. Must be experienced. Lunchson vouchers. No Saturdays. Chambealare & Partier, 29 Bedford Row, London, V.I. Telephone: CHAncery 8426.

SITUATIONS VACANT. Reinforced concrete designerdetailers and detailers required by Leonano & Grant' in their South Losdon and Edinburgh offices. Applicants should have three years' minimum experience in position applied for. Good salaries and prospects, luncheon vouchers, etc. Interview by appointment. Telephose: London, McCaulay 6477; Edinburgh, CAL 3607.

SITUATION VACANT. Consulting engineers with long experience in colliery and industrial structures, having opened an office in Chesterfield, require a capable engineer-designer, with good background in reinforced concrete design, and sound drawing office experience, to take charge of small drawing office, and assist principal with general contract administration, accounts, and estimating. Send full details to J. C. Huchins & Paryners, Vauxhall House, Beetwell Street, Chesterfield.

REINFORCED CONCRETE DESIGNERS AND DETAILERS

required in new drawing office just opened in centre of Birmingham, and in Sale, Cheshire. A wonderful opportunity to join a leading and expanding group of companies. For further information write, in confidence, to J. E. LEHMARD, RICHARD HILL LTD., 7 Cleveland Row, St. James's, London, S.W. 1 (or telephone WHItehall 3100) or D. Halstead, 198 School Road, Sale, Cheshire (telephone Sale 827)

MIDDLESEX COUNTY COUNCIL

ARCHITECT'S DEPARTMENT

(1) STRUCTURAL ENGINEERING ASSIST-ANTS, A.P.T. IV (£1,140-£1,310 plus L'andon Weighting £45). Must have considerable experience in designing and detailing reinforced cocrete, and also have experience of structural steelwork design. Professional qualifications an advantage.

(2) A.P.T. III (£935-£1,140 plus London Weighting £45). Must be good draughtsman with experience in detailing reinforced concrete, with good knowledge of design. Structural steelwork experience an advantage.

(3) A.P.T. II U815-L960 plus London Weighting up to L40). Must have good general knowledge of structural engineering and be nest and expeditious draughtsman. Excellent opportunities for design experience.

All posts: Established. Pensionable.
Prescribed conditions.

Application forms from the COUNTY ARCHITECT 2 Queen Anne's Gate Buildings, Dartmouth Street, London, S.W.1, returnable by May 5th. (Quote F583,C&CE.)

DESIGN DRAUGHTSMAN

Applications are invited from design-draughtsmen with experience in structural reinforced concrete work, for an interesting post in the Design Office of a company specialising in the design and erection of a wide and varied range of concrete structures.

The successful applicant will become a member of a small team in an expanding organisation which offers scope for initiative and progress. A good progressive salary will be offered together with non-contributory pension and superior staff conditions. Assistance with housing will be available if required.

Applications in confidence, stating age, details of training, experience and qualifications if any, availability, and some indication of commencing salary required, should be addressed to:

A. Robertson, A.I.O.B.

General Manager

CONCRETE SERVICES LTD

Ouse Acres Boroughbridge Road York SITUATION VACANT. Young civil or structural en-gineer (with bias towards structural steelwork) required as assistant to chief structural engineer by London consultants. Projects in U.K. and overseas. Apply in ertiing to Mandasstan & Partners, 38 Grosvenor Gardens, London, S.W.I.

STAFFORDSHIRE COUNTY COUNCIL

County Architect's Department Appointment of

ASSISTANT STRUCTURAL ENGINEER

Applications are invited from chartered struc-tural engineers for the above post within Grade A.P.T. IV (fi,140-fi,130 per anum). The Council may be able to assist with housing accommodation in cases of need, and also has a scheme for loans to employees wishing to purchase

their own houses.
Good working conditions. Assistance with

their own working conditions.

Good working conditions.

removal expenses, etc.

Forms of application from P. Woodcock,
F.R.I.B.A., COUNTY ARCHITECT, Green Hall,
Lichfield Road, Stafford.

Closing date: March 27th, 1961.

Closing date: March 27th, 1961.

Closing date: County Council

REINFORCED CONCRETE DETAILERS

Suppl.

DRAUGHTSMEN

preferably with knowledge of building construction preferably with knowledge of continue construction required by precast concrete specialists at their head office near Guildford. Varied work with good prospects, superanauation, etc. Salary by good prospects, superannuation, etc. Salas arrangement according to qualifications experience.

Apply to:

THE SENIOR STRUCTURAL ENGINEER MARLEY CONCRETE LTD PEASMARCH, GUILDFORD, SURREY

BARBICAN REDEVELOPMENT SITE SUPERVISOR

CLERK OF WORKS

A senior site supervisor is required on April 1st or earlier for the Barbican Redevelopment scheme shortly to begin in the City of London. The employment could extend over a period of 7 years. As there will eventually be a small staff of cleries of works it is intended to engage at this time one of the senior staff to work in close collaboration with the architects in order that he may acquire a thorough knowledge of the nature and scope of the work as a whole. Applicants most have a wide experience in large-scale building projects, and professional qualifications in architecture, engineering or building surveying would be of value.

Applications should be addressed to CHAMBERLIN, Approximation (Barbscan), 75-76 Little Britain, London, E.C.1, stating age, experience, qualifications, and salary expected.

SITUATIONS VACANT. A number of vacancies available for reinforced concrete and steelwork draughtsmen and designers in well-known consulting engineers' Westminster office, where specialisation is avoided and opportunity exists to learn all aspects of civil and structural engineering. A high rate of earnings paid to those with initiative and ability. Box 4741, CONCRETA AND CONSTRUCTIONAL ENGINEERING, 14 Dartmonth Street London, S.W. Street, London, S.W.r.

SITUATIONS VACANT. Reinforced concrete de-signers and detailers - YOUR OWN BUREAU— no fees. Permanent positions. Call BUSINESS VACANCIES BUREAU, 28 Victoria Street, London, S.W.I. Telephone Abbey 7200.

CHIEF STRUCTURAL DESIGN ENGINEER

Engineer, age 35-65, required by consulting en-gineers to supervise structural design work in their Westminster office. Applicants must be corporate members of the Institution of Structural Engineers and have had extensive and varied experience in reinforced and prestressed concrete design. Some reinforced and preserved conserved and design experience also in water-retaining structures and in structural steelwork an advantage but not essential. Pension scheme. Written applications to Binnie, Deacon & Gourley, Artillery House, Artillery Row, London, S.W.1.

SERVICES OFFERED.

SERVICES OFFERED. Accurate and rapid design and/or detailing service for all types of reinforced concrete work offered to the profession by competent team led by qualified engineer. Quotations for all jobs. R. E. Evesor & Parrusers, t Speedwell Road, Birnningham, S. Telephone

SERVICES OFFERED. Qualified engineer, wide experi-ence in reinforced concrete and structural steelwork, will undertake work in own home for consulting engineers, etc. Designs and completed working drawings for any type of STRUCTURE will be produced quickly and efficiently. Box 4736, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 24 Dartmouth Street, London, S.W.1.

SERVICES OFFERED. Complete design, detailing and bending schedules executed by experienced engineers for all types of prestrensed and reinforced concrete structures offered to the profession. Prompt and accurate service assured. Box 4740, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.I.

SERVICES OFFERED. Experienced engineer offers prompt services to consulting engineers for the design and detailing or estimating of all types of reinforced concrete structures, including shell roofs (Midland area). BOX 4742, CONCRETE AND CONSTRUCTIONAL ESCINEER-100, 14 Dartmouth Street, London, S.W.I.

SERVICES OFFERED. Capacity available for con-sulting engineers for the design and detailing of all types of reinforced concrete and steel frame buildings, heavy industrial structures and foundations, road works, etc. Drawing Offices Services. Telephone: Tulse Hill

DESIGN SERVICES

offered to the profession by civil engineer with first-class industrial experience. Box 4743. CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 DATHOUGH Street, London, S.W.I.

FOR SALE.

FOR SALE. Steel fencing stakes, chain link, etc. E. Stephens & Son Ltd., Bath Street, London, E.C.1. Clerkenwell 1731.

STONE X COURT ACCREGATES



General View of Plant at Richmonoworth,

ONE OF OUR MODERN CONCRETE AGGREGATES PLANTS

First-Class Washed graded concrete aggregates, and shingles for road dressing, coupled with efficient delivery, are at the service of contractors and Municipal Authorities in London, Berks, Bucks, Herts, and Middlesex Areas.

Our products include Washed Sharp Sand, all sizes of shingles, from 3/16" up to 2", either crushed or natural.

Special Specifications made to order.



STONE COURT BALLAST CO. LTD. PORTLAND HOUSE, TOTHILL ST., WESTMINSTER, S.W.J.

Telephone: Abbay 3454.



SITUATION VACANT. Young civil or structural engineer (with bias towards structural steelwork) required as assistant to chief structural engineer by London consultants. Projects in U.K. and overseas. Apply in writing to Mandemaran & Paraylesses, 36 Grosvenor Gardens, London, S.W.I.

STAFFORDSHIRE COUNTY COUNCIL

County Architect's Department Appointment of

ASSISTANT STRUCTURAL ENGINEER

Applications are invited from chartered struc-tural engineers for the above post within Grade A.P.T. IV (f.1,40-f.1,310 per annum). The Council may be able to assist with housing accommodation in cases of need, and also has a scheme for loans to employees wishing to purchase their own bosses.

their twen servicing conditions (Good working conditions) (Good working conditions) (Fernal of application from P. Woodcock, F.R.I.B.A., COUNTY ARCHITECT, Green Hall, Lichfield Road, Stafford.

Closing date: March 27th, 1961.

T. H. Evans,

Clerk of the County Council

REINFORCED CONCRETE DETAILERS

Smil

DRAUGHTSMEN

preferably with knowledge of building construction required by precast concrete specialists at their head office near Guildford. Varied work with good prospects, superannuation, etc. Salary by arrangement according to qualifications experience.

Apply to:

THE SENIOR STRUCTURAL ENGINEER MARLEY CONCRETE LTD PEASMARSN, GUILDFORD, SURREY

BARBICAN REDEVELOPMENT SITE SUPERVISOR or

CLERK OF WORKS

A senior site supervisor is required on April 1st or earlier for the Barbican Rodevelopment scheme shortly to begin in the City of London. The employment could extend over a period of 7 years. there will eventually be a small staff of clerks of works it is intended to engage at this time one of the senior staff to work in close collaboration with the architects in order that he may acquire a thorough knowledge of the nature and scope of the work as a whole. Applicants must have a wide experience in large-scale building projects, and professional qualifications in architecture, engineering or building surveying would be of

Applications should be addressed to Chamberlin, Powell & Bon (Barbican), 75-76 Little Britain, London, E.C.1, stating age, experience, qualifications, and salary expected.

SITUATIONS VACANT. A number of vacancies avail-SITUATIONS VACANT. A number of vacancies avanable for reinforced concrete and steelwork draughtsmen and designers in well-known consulting engineers' Westminster office, where specialisation is avoided and opportunity exists to learn all aspects of civil and structural engineering. A high rate of earnings paid to those with initiative and ability. Box 4741, CORCRETE AND CONSTRUCTIONAL ENGINEERING, 14 DERIMOUTH Street, London, S.W.1.

SITUATIONS VACANT. Reinforced concrete designers and detailers - YOUR OWN BUREAU—no fees. Permanent positions. Call BUSINESS VACANCIES BUREAU, 28 Victoria Street, London, S.W.I. Telephone Abbey 7206.

CHIEF STRUCTURAL DESIGN ENGINEER

Engineer, age 35-45, required by consulting en-gineers to supervise structural design work in their Westminster office. Applicants must be corporate members of the Institution of Structural Engineers and have had extensive and varied experience in reinforced and prestressed concrete design. Some design experience also in water-retaining structures and in structural steelwork an advantage but not essential. Pension scheme. Written applications and its structural steelwork an advantage but not essential. Pension scheme. Written applications to Birshe, Deacon & Gourley, Artillery House, Artillery Row, London, S.W.I.

SERVICES OFFERED.

SERVICES OFFERED. Accurate and rapid design and/or detailing service for all types of reinforced concrete work offered to the profession by competent team led by qualified engineer. Quotations for all jobs. R.E. Eveson & Partners, t Speedwell Road, Birmingham, 5. Telephone Calthorpe 2594

SERVICES OFFERED. Qualified engineer, wide experi-ence in reinforced concrete and structural steelwork, will undertake work in own home for consulting engineers, etc. Designs and completed working drawings for any type of structure will be produced quickly and efficiently. Box 4736, Concrete and Constructional Engineering, 14 Dartmouth Street, London, S.W.z.

SERVICES OFFERED. Complete design, detailing and bending schedules executed by experienced engineers for all types of prestressed and reinforced concrete structures offered to the profession. Prompt and accurate service assured. BOX 4740. CONCRETE ABD CONSTRUCTIONAL assured. Box 4740, CONCERTE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.I.

SERVICES OFFERED. Experienced engineer offers SERVICES OFFERED. Experienced engineer offers prompt services to consulting engineers for the design and detailing or estimating of all types of reinforced concrete structures, including shell roots (Midland area). Box 4742, CONCRETE AND CONSTRUCTIONAL ENGINEER. ING, 14 Dartmouth Street, London, S.W.1

SERVICES OFFERED. Capacity available for con-sulting engineers for the design and detailing of all types of reinforced concrete and steel frame buildings, heavy industrial structures and foundations, road works, etc.

Drawing Offices Services. Telephone: Tulse Hill GEOS.

DESIGN SERVICES

offered to the profession by civil engineer with first-class industrial experience. Box 474
Concrete and Constructional Engineering
14 Dartmouth Street, London, S.W.I.

FOR SALE.

FOR SALE. Steel fencing stakes, chain link, etc. E. STEPHERS & SON LTD., Bath Street, London, E.C.r. Clerkenwell 1731.

STONE * COURT ACCREGATES



General Vine of Plant at Rickmansworth.

ONE OF OUR MODERN CONCRETE AGGREGATES PLANTS

First-Class Washed graded concrete aggregates, and shingles for road dressing, coupled with efficient delivery, are at the service of contractors and Municipal Authorities in London, Berks, Bucks, Herts, and Middlesex Areas.

Our products include Washed Sharp Sand, all sizes of shingles, from 3/16° up to 2°, either crushed or natural.

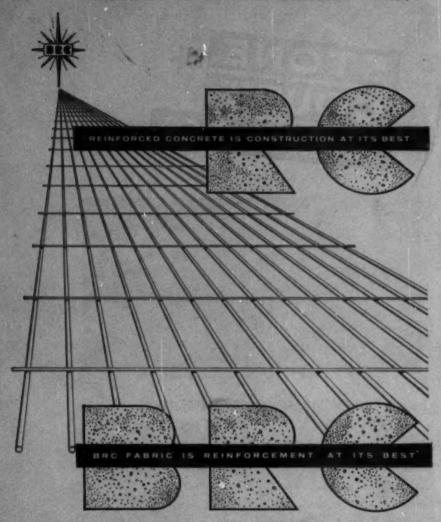
Special Specifications made to order.



STONE COURT BALLAST CO. LTD.
PORTLAND HOUSE, TOTHILL ST., WESTHINSTER, S.W.I

Telephone: Abbey 3456.





Specialists in Reinforced Concrete Design and Suppliers of Reinforcement

THE BRITISH REINFORCED CONCRETE ENGINEERING CO. LTD., STAFFORD

Landon, Birmingham, Bristol, Chelmsford, Leeds, Leicaster, Liverpool, Manchester, Newcostle, Cardiff. Glasgow, Dublin, Belfast, Bulawayo, Calcutta, Johannesburg, Singapore, Vancouver Export Sales: 54 Groevenor Street, Landon W.1

